23. Program Structure

23.1 Introduction

In this chapter, we give an overview of the programs of the *Bernese GPS Software* Version 4.2. This includes the program structure and a complete list of all *Bernese* programs. We also include the programs which are **not** supported by the menu system.

Furthermore, we add remarks concerning programming standards and programming conventions for those users who, for whatever reason, would like to (or have to) change the source code.

In Chapter 3, we saw that the *menu system* makes the interaction between the user and the programs much easier. Here, we only consider the *GPS/GLONASS main programs*. If there is a menu program available for a specific GPS main program, the name of the menu program may be derived from the (usually 6-character) name of the main program by adding a "`_P`".

23.2 Overview of the Program Structure

The directory structure is shown in Figure 23.1. The directory abbreviations are given in this figure for the UNIX system (first entry), the VMS system (second entry), and the DOS system (third entry).

The root directory `$C` (UNIX) or `C:` (VMS or DOS) of the *Bernese GPS Software* Version 4.2 may be defined by the user (e.g., `BERN42`). Below, we give a short description of the contents of its subdirectories:

`PGM` In the *program* directory and its subdirectories, all `FORTRAN` source files of the main programs are stored.

- `MAIN42` contains all important programs dealing with the processing of the GPS observations.
- `MENU42` contains the programs of the menu system.
- `BPE42` contains all programs necessary for the automated processing.

`LIB` The *library* directory contains five subdirectories.

- `ASTLIB42` contains general routines (e.g., inversion routines, transformation routines, astronomical routines).
- `GPSLIB42` contains most of the subroutines called by the `MAIN42` programs.

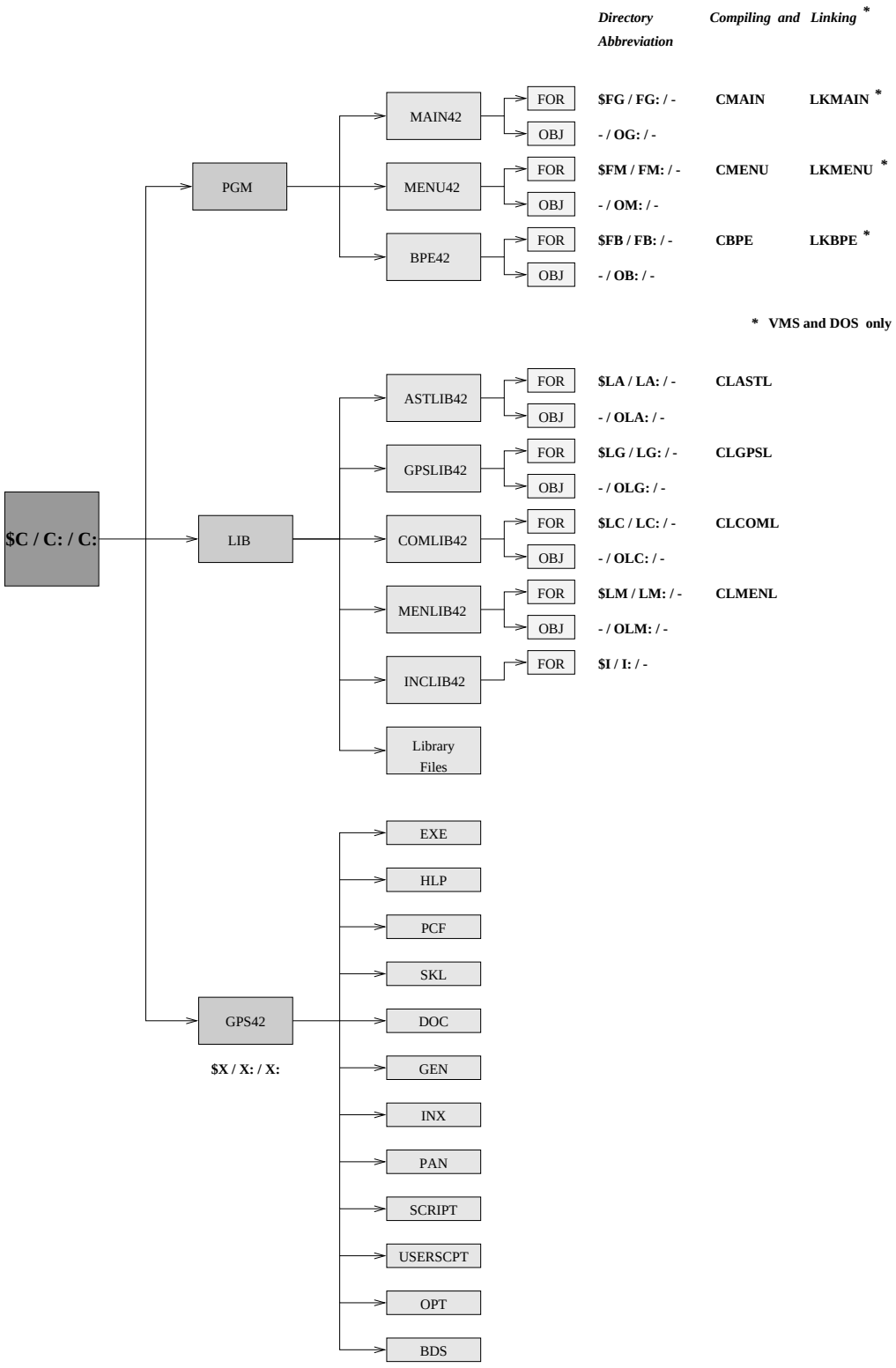

Figure 23.1: Program structure of the *Bernese GPS Software* Version 4.2.

`COMLIB42` contains most of the subroutines which are platform-dependent (DOS: `L_*.FOR`, UNIX: `U_*.f`, VMS: `VMS_*.FOR`). For the UNIX version, you also find some `C` routines here. The linking process on some platforms makes it necessary to store some platform-dependent routines also in the `ASTLIB42` and the `MENLIB42` directories.

`MENLIB42` contains most of the subroutines called by the `MENU42` programs.

`INCLIB42` contains the `FORTRAN` include files.

`GPS42` This directory contains software-related files of various kinds. Many of these files are described in Chapter 24.

`EXE` contains command files (scripts) to compile and link particular routines or to recompile all modules of the software.

`HLP` contains the help panels. Help panels may be displayed on request as on-line help for each input panel of the menu system.

`PCF` contains an example of a process control file for the BPE (see Chapter 22).

`SKL` contains skeleton files needed by the menu system to prepare the input files for the Bernese main programs.

`DOC` contains documentation files (in ASCII or in postscript format), such as the installation guide and the entire software documentation.

`GEN` contains important general files (e.g., satellite information files, geodetic datum definition files, the definition of the constants to be used by the Bernese programs, etc.).

`INX` contains the necessary input file examples for the programs of the `MAIN42` directory which are **not** supported by the menu system.

`PAN` contains the original panels (master copies). On a multi-user system, these panels are copied automatically to the corresponding user directories (`$U/PAN` or `U:[PAN]`) during the installation.

`SCRIPT` contains basic command files which are necessary for the automated processing using the BPE.

`OPT` contains the panels for the example PCF files in the directory `PCF`. These panels are copied automatically to the corresponding user directories (`$U/OPT` or `U:[OPT]`).

`USERSCPT` contains the scripts of the example PCF files in the directory `PCF`. These scripts are copied automatically to the corresponding user directories (`$U/SCRIPT` or `U:[SCRIPT]`).

`BDS` contains the original "BDS" files (*platform-independent* script language internally used to create the *platform-dependent* command files which are given in the directory `SCRIPT`, see Chapter 22).

Predefined *campaign-specific* directories `$P`, `$Q` (UNIX) or freely definable campaign directories (UNIX, VMS, DOS) are not included in Figure 23.1. The data disk(s) may therefore be completely separated from the disk containing the Bernese programs.

23.3 Summary of the GPS/GLONASS Main Programs

The programs of the *Bernese GPS Software* Version 4.2 in the directory `MAIN42` may be arranged according to Figure 1.1. This subdivision of the programs is also reflected in the structure of the

menu system (Menu 0.2):

(1) transformation part (Menu 2 , see Chapter 7),

(2) orbit part (Menu 3 , see Chapter 8),

(3) processing part (Menu 4 , see Chapters 10 to 19),

(4) simulation part (*not* supported by the menu system, see Chapter 20), and

(5) service part (Menu 5 , see Chapter 21).

The following table gives an overview and a short description of the individual program units of the five parts of the software.

Table 23.1: List of the *Bernese GPS Software* Version 4.2 main programs.

Name	Menu	Purpose
Transformation part:		
TRRINEXO	2.5.1.1	Transform Trimble code/phase data into RINEX data
TRRINEXN	2.5.1.2	Transform Trimble broadcast data into RINEX data
ASRINEXO	2.5.4.1	Transform Ashtech code/phase data into RINEX data
ASRINEXN	2.5.4.2	Transform Ashtech GPS broadcast data into RINEX data
ASRINEXG	2.5.4.2	Transform Ashtech GLONASS broadcast data into RINEX data
RGRINEXO	2.5.5.1	Transform Rogue code/phase data into RINEX data
RGRINEXN	2.5.5.2	Transform Rogue broadcast data into RINEX data
CCRINEXO	2.5.6.1	Concatenate RINEX observation files
CCRINEXN	2.5.6.2	Concatenate GPS RINEX navigation file
CCRINEXG	2.5.6.4	Concatenate GLONASS RINEX navigation file
CCRINEXM	-	Concatenate RINEX meteo file
CCPREORB	2.5.6.3	Concatenate precise orbit files
RNXSPLIT	2.5.7	Split multiple-station RINEX observation files
RXMETEO	2.5.9	RINEX meteo file creation

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Name	Menu	Purpose
BV3RXO	2.6.1	Transform Bernese code/phase data into RINEX files
BV3RXN	2.6.2	Transform Bernese broadcast data into RINEX files
RXOBV3	2.7.1	Transform RINEX code/phase data into Bernese files
RXNBV3	2.7.2	Transform RINEX broadcast data into Bernese files
RXMBV3	2.7.3	Transform RINEX meteo data into Bernese files
RNXGRA	2.7.4	Pseudo-graphics of RINEX observation files
RNXCYC	2.7.5	Preprocessing on the RINEX level
RNXSMT	2.7.6	Clean Rinex data and smooth the code observations
RXNPRE	2.7.7	Transform GPS/GLONASS broadcast files into precise format
DCBINX	-	Include DCB information in IONEX files
IONINX	-	Convert Bernese ionosphere (ION) files to IONEX (INX) files
INXDCB	-	Convert IONEX DCB information to Bernese DCB information
RXSTATUS	-	Produce a 2-lines summary for RINEX files
Orbit part:		
BRDCHK	3.1.1	Check broadcast files (interactive version)
BRDTST	3.1.2	Check broadcast files (automatic version)
BRDTAB	3.2	Transform broadcast orbits into tabular orbits
PRETAB	3.2	Transform precise orbits into tabular orbits
ORBGEN	3.3	Generate/update standard orbits
STDDIF	3.6	Display differences between two standard orbits
STDPRE	3.7	Produce precise eph. format from standard orbit
SATCLK	3.8	Extract satellite clock information from broadcast messages
DEFO93	3.9.1	Extended orbit model: generate standard orbit
UPDO93	3.9.2	Extended orbit model: update standard orbit
ORBIMP	3.9.3	Extended orbit model: fit orbit using precise orbit information as observations
STDELE	3.9.4	Comparison of osculating elements
ORBCMP	-	Helmert transformation between different precise orbits
STDHLM	-	Helmert transformation between two standard orbits
STDPLT	-	Compute differences between 2 standard orbits and create plot file
Processing part:		
CODCHK	4.1	Check code zero- or single-difference files
CODSPP	4.2	Single point positioning using code
SNGDIF	4.3	Form single-difference observation- and header-files
OBSTST	4.4.1	Check phase single-difference files for cycle slips (old version)
MAUPRP	4.4.2	Manual/automatic phase preprocessing (cycle slips, outliers)
GPSEST	4.5	Parameter estimation program
IONEST	4.7	Estimation of ionosphere models
ADDNEQ	4.8.1	Combination of solutions based on normal equations
ADDNEQ2	4.8.3	Combination of solutions based on normal equations (new version)
Simulation part:		
GPSSIM	-	Simulation of GPS code/phase observations
Service part:		

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Name	Menu	Purpose
SATGRA	5.1	Graphical display of observation files
SATMRK	5.1	Mark/reset observation flags
OBSSPL	5.1	Split observation files
CHGHED	5.2	Change header information of observation files
REDISP	5.3.1	Display residual files
RESRMS	5.3.2	Check residuals for outliers
COMPAR	5.4.1	Comparison of several coordinate sets, repeatabilities
HELMR1	5.4.2	Helmert transformation between two coordinate files
CRDMRG	5.4.5	Merge coordinate files
POLUPD	5.5.1	Reformat and update pole format
POLXTR	5.5.2	Compose continuous pole file from a series of pole files
CODXTR	5.6.1	Extraction summary of CODSPP output
DEFXTR	5.6.2	Extraction summary of ORBGEN output
MPRXTR	5.6.3	Extraction summary of MAUPRP output
GPSXTR	5.6.5	Extraction of coordinates, baselines, ambiguities from GPSEST/ ADDNEQ output
PREWEI	5.6.7	Change accuracy codes of precise orbit files
OBSFMT	5.7.1	Transform binary header- and obs-files into ASCII
FMTOBS	5.7.2	Transform ASCII into binary header- and obs-files
STDFMT	5.7.3	Transform std. orbit and radiation pressure coeff. files into ASCII
FMTSTD	5.7.4	Transform ASCII into std. orbit and radiation pressure coeff. files
NEQ2ASC	5.7.5	Transform binary NEQs from ADDNEQ2 into ASCII NEQs and vice versa
NEQFMT	-	Transform binary NEQs from ADDNEQ into ASCII NEQs and vice versa
NEQ2NQ0	-	Transform binary NEQs from ADDNEQ format into ADDNEQ2 format
AMBCHK	-	Check resolved ambiguities from different resolution strategies
BASLST	-	Create list of baselines for ambiguity resolution
BLHXYZ	-	Transform geographic coordinates into geocentric x-y-z coordinates
COOSYS	-	Apply Helmert parameters to a coordinate set
COOVEL	-	Propagate coordinates with a given velocity field
ERPEST	-	Estimate amplitudes of specific frequencies from ERP results
NUVELO	-	Compute NUVEL1 or NUVEL1A velocities
INXDIF	-	Compare IONEX-based ionosphere maps
INXTST	-	Extract mean, maximum, and minimum TEC from global IONEX data
PHCCNV	-	Transform Antenna phase center corrections into the Bernese format
PRPMET	-	Transform estimated TRP files into meteo input files (MET)
SNXNEQ	-	Transform SINEX file (V0.05, V1.00) into Bernese NEQ files in ADDNEQ format
SNX2NQ0	-	Transform SINEX file (V0.05, V1.00) into Bernese NEQ files in ADDNEQ2 format

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Name	Menu	Purpose
SP3SP1	-	Transform precise SP3 orbit format into SP1 format
SP3SP2	-	Transform precise SP3 orbit format into SP2 format
SUBDIF	-	Compare different sub-daily ERP models
WD2PWV	-	Extract PWV values from zenith wet delay values from TRP files

To run programs which are not included in the menu system (indicated by the symbol "-" in Table 23.1), you may use the RUNGPS command (see Section 3.8). In that case you have to "manually" prepare the program input files (so-called N-, F-, and I-files).

23.4 Flow Diagrams and Decompositions

In the documentation of the former versions of the *Bernese GPS Software* flow diagrams and decompositions were included for each program. This information is of interest for those users wishing to understand the programs in more detail. This information is still available on request. Please contact the Bernese team in order to obtain the decomposition files for a particular program (or for all programs).

23.5 Programming Standards and Conventions

Almost all programs in the MAIN42 directory as well as the menu system programs of the MENU42 directory are written in Fortran 77. An exception is, e.g., ADDNEQ2, which is written in Fortran 90. Future versions of the *Bernese GPS Software* will contain more programs coded in Fortran 90, as this is the new standard programming language for the *Bernese GPS Software*. Those users who would like to make changes in the programs have to look at the following aspects:

(1) maximum dimensions,

(2) COMMON declarations,

(3) recompilation of particular programs.

23.5.1 Maximum Dimensions and Commons

Most of the main programs contain in the declaration part maximum dimensions. Figure 23.2 shows the maximum dimensions for the program COMPAR as an example.

Three memory models containing maximum dimensions are defined in the source code (SMALL, MEDIUM, LARGE). The appropriate model is selected for a given computer platform. To increase a specific parameter (e.g., MAXSTA), you may change the corresponding entry (e.g., change MAXSTA=200 to MAXSTA=300). The necessary *recompilation* has to be done according to Section 23.6.

Usually, it is enough to change the parameters in the main programs. The values of the maximum dimensions are passed to the subroutines using the Fortran COMMON blocks (see Figure 23.3).

In some cases, the subroutines use *local* variables for *local* maximum dimensions. Therefore, it may happen that some subroutines issue an error message, if you increased a dimension parameter

```
C
C MAXIMAL DIMENSIONS
C ------------------
      PARAMETER (MAXFLG= 10,MAXLIN= 40,MAXFLD=  1,MAXBSL=2000)
C_BEG_SIZE_SMALL
C     PARAMETER (MAXFIL= 50,MAXSTA=200)
C_END_SIZE_SMALL
C_BEG_SIZE_MEDIUM
C     PARAMETER (MAXFIL=740,MAXSTA=200)
C_END_SIZE_MEDIUM
C_BEG_SIZE_LARGE
      PARAMETER (MAXFIL=740,MAXSTA=500)
C_END_SIZE_LARGE
```

Figure 23.2: Maximum dimension declaration of the main program COMPAR.

```
C
C COMMON BLOCKS
C -------------
      COMMON/MCMFIL/MXCFIL,MXNFIL
      COMMON/MCMSTA/MXCSTA,MXNSTA
C
C INITIALIZE COMMON BLOCKS FOR MAXIMAL DIMENSIONS
C -----------------------------------------------
      MXCFIL=MAXFIL
      MXNFIL='MAXFIL'
      MXCSTA=MAXSTA
      MXNSTA='MAXSTA'
```

Figure 23.3: Common blocks defined in the main program COMPAR.

in a main program. To successfully run the changed program, you may then have to correct local dimensions in some subroutines, too. In the next section, we explain how to recompile a subroutine.

For a maximum dimension statement occurring in many programs (such as `MAXSTA` or `MAXSAT`), it makes sense to search (using the UNIX command `grep` or the VMS command `SEARCH`) for the corresponding string. This may help to reduce the number of iterations considerably.

Problems related to the change of a maximum dimension parameter may arise if the computer memory is insufficient to allow for the increased program size. This may happen, if "memory-critical" parameters are changed such as the parameters `MAXPAR`, `MAXSAS`, `MAXFLS`, `MAXSNG` in program GPSEST, or parameters `MAXPAR`, `MAXNEQ` in program ADDNEQ. The increased program size may also increase the program run-time considerably, if the operating system starts swapping in and out parts of the memory.

23.6 Recompilation of Particular Programs

A set of scripts is provided in the `$X/EXE` directory for the compilation and linking of programs and routines. For the names and the usage of these scripts, we refer to the chapter on the installation of the *Bernese GPS Software* on different platforms (see Chapter 25).

To recompile, e.g., on UNIX and VMS platforms the subroutine GETSTA in the directory `GPSLIB42`, use the command `CLGPSL GETSTA`. To recompile and link, e.g., the main program COMPAR (which calls the SR GETSTA) in the directory `MAIN42`, enter the command `CMAIN COMPAR`. On the VMS platform, the link command `LKMAIN COMPAR` has to be used to activate the changes.

On a DOS system, the `CMP` script can be used for both steps. The command `CMP GETSTA` compiles the routine `GETSTA` and updates the corresponding library, `CMP COMPAR` compiles the program COMPAR and links it with the (updated) library.

Please note that many routines are called from several programs/routines. An unexperienced Bernese user, wishing to modify a routine, should therefore use the mentioned `grep` or `SEARCH` command to find the affected programs.

24. Data Structure

24.1 Introduction

This chapter gives an introduction into the data structure of the *Bernese GPS Software* Version 4.2. This includes a detailed description of the data files and formats used in the software. We start with general input files used by most of the programs and conclude with a variety of output files.

24.2 Overview of the Data Structure

There are four major categories of files:

(1) *general files,*
(2) *campaign-specific files,*
(3) *user-specific files,*
(4) *temporary files*.

These four categories are illustrated in Figure 24.1. The directory abbreviations are given for the UNIX system (first entry), the VMS system (second entry), and the DOS system (third entry). The data area abbreviations have to be defined on all Systems (e.g., in the `LOADGPS` script) and are in principle arbitrary. All "program area" subdirectories are shown in Figure 23.1.

General files and skeleton files (master copies) are stored in the *program-specific directories*. We have a closer look at these general files in Section 24.4. An overview of the other directories of this category (`USERSCPT`, etc.) was given in the previous chapter (see Section 23.2).
There is a close connection between the files in some of the program-specific directories, in the user-specific directories and the temporary directories: The `SKL` files are the skeleton files used by the menu programs for the generation of the `INP` files (program input files) in both the user-specific (for manual processing) and the temporary area (for automated processing using the BPE). The directories `OPT`, `PAN`, `PCF`, and `USERSCPT` contain master copies of panel options and script files. The content of these directories is copied to the user-specific directories `OPT`, `PAN`, `PCF` and `SCRIPT` when creating the user area. With the exception of the directory `GEN` most of the data files belonging to the program area are of technical nature (e.g., the `I`-, `N`-, `F`-, and `T`- files, see Section 24.9 or Chapter 3). We therefore do not put much emphasis on these files, here.

All *campaign-specific files* are stored in the campaign directories `ATM`, `DATPAN`, `OBS`, `ORB`, `ORX`, `OUT`, `RAW`, and `STA`. A detailed overview of the content of important files in these subdirectories

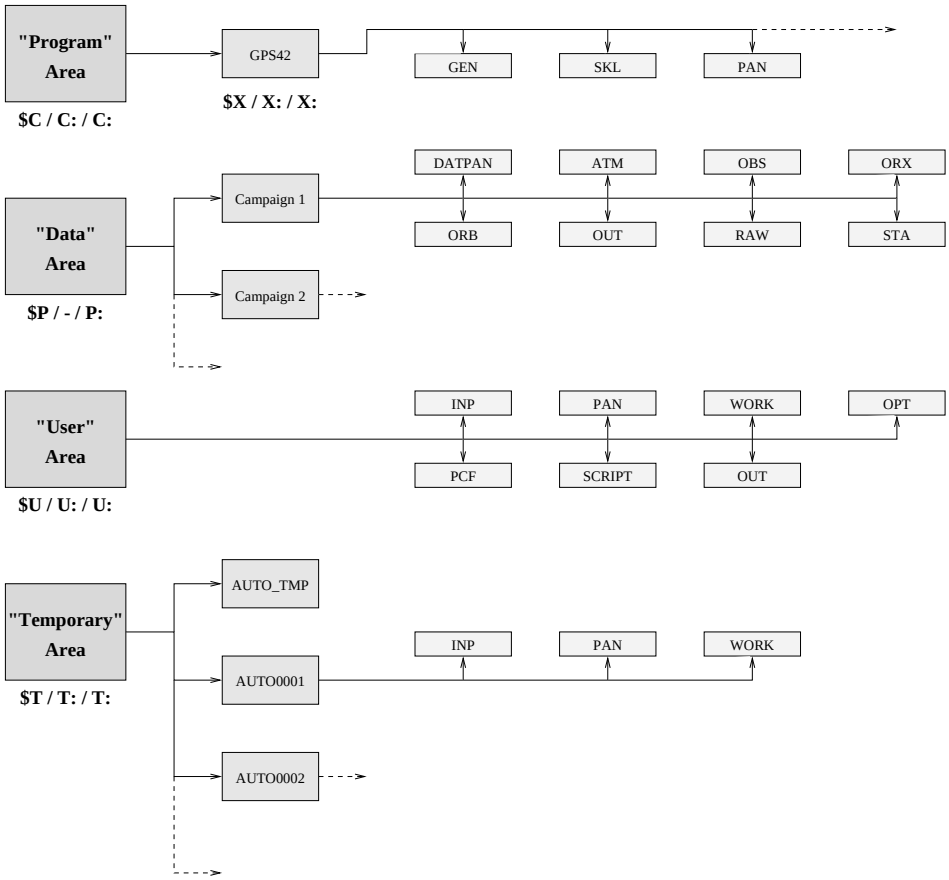

Figure 24.1: Data structure of the *Bernese GPS Software* Version 4.2.

is given in the next sections of this chapter. The names of the subdirectories are not fixed. They might be changed using the menu system (Menu 0). This is not recommended, however. More information may be found in the Chapters 3 and 5.

User-specific data directories are used for the manual processing mode. Most of the directories contain, as mentioned, copies from the master files of the program directories: `INP` (from `INX` or `SKL`) or the directories `OPT`, `PAN`, `PCF`, `SCRIPT` stemming from the directories with the same names in the "program area" (Exception: files in the user directory `SCRIPT` stem from the master directory `USERSCPT` and not `SCRIPT`; see also Chapter 23). The directory `WORK` is used in the manual processing mode for temporary copies of files or for scratch files. The directories `SCRIPT` and `PCF` are used for the BPE, only.

Temporary files are important when processing with the BPE (see Chapter 22). The files of this group are, in principle, nothing else than local copies for the automated processing with the BPE.

24.3 Overview of the Data Files

The file types involved in the *Bernese GPS Software* Version 4.2 are summarized in this first section. In the following sections we will explain the content of the files in more detail. We concentrate on

some specific directories: the *general files* of the program-specific area and all important files of the *campaign-specific* area.

We may also divide the file types according to Menu 0.3 into the following groups (see Chapter 5).

GENERAL	General files: Menu 0.3.1 (*general data* files stored in the *program-specific* directory GEN).
OBSERVATIONS	Observation files: Menu 0.3.2 (raw data, RINEX data, Bernese observation files). Stored in the campaign-specific directories ORX, RAW, and OBS.
ORBITS	Orbit files: Menu 0.3.3 Stored in the campaign-specific directory ORB.
MISCELLANEOUS	Miscellaneous files: Menu 0.3.4 Stored in the campaign-specific directories STA, ATM, ORB, and OUT.
BPE	BPE files: Menu 0.3.5 (usually stored in the user area, master files also available in the program-specific directories).

Table 24.1 summarizes the data files, ordered according to the directory structure (and not according to the menu items), and gives a short description for each file type. The directory names are those of the UNIX version. "..." stands for file names or file extensions chosen by the user.

Table 24.1: List of the *Bernese GPS Software* Version 4.2 data files.

Menu	Example file	Ext.	Section	Purpose
GENERAL files: directory $X/GEN				
0.3.1	CONST.	-	24.4.1	All physical constants used in the program system
0.3.1	DATUM.	-	24.4.2	Geodetic datum information
0.3.1	RECEIVER.	-	24.4.3	Receiver characterization file
0.3.1	...	TRN	24.4.4	Receiver/antenna name translation table
0.3.1	PHAS_IGS.01	-	24.4.5	Antenna phase center offsets and patterns
0.3.1	GEMT3.	-	24.4.6	Earth potential coefficients
0.3.1	JGM3.	-	24.4.6	Earth potential coefficients
0.3.1	C04_2000.ERP	-	24.4.7	Pole coordinates, UT1-UTC, UTC-GPS
0.3.1	POLOFF.	-	24.4.8	Pole offsets of the combined C04 pole series
0.3.1	SINEX.	-	24.4.9	General information file to be included in SINEX output files
0.3.1	IONEX.	-	24.4.10	General information file to be included in IONEX output files
0.3.1	SATELLIT.TTT	-	24.4.11	Satellite information file
0.3.1	SAT_2000.CRX	-	24.4.12	Satellite problem file
0.3.1	STACRUX.	-	24.4.13	Station problem file for ADDNEQ
0.3.1	STACRUX.NEW	-	24.4.14	Station problem file for ADDNEQ2
RINEX files: directory RAW RINEX file names and extensions in transfer programs selectable should follow the RINEX convention (see Section 24.5)				

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Menu	Example file	Ext.	Section	Purpose
-	...	...	24.5	RINEX observations
-	...	...	24.5	RINEX broadcast messages
-	...	...	24.5	RINEX meteo data
OBSERVATION files: directory `OBS`				
0.3.2	...	`CZH`	24.6	Header file for code observations
0.3.2	...	`CZO`	24.6	Code observations
0.3.2	...	`PZH`	24.6	Header file for phase observations
0.3.2	...	`PZO`	24.6	Phase observations
0.3.2	...	`CSH`	24.6	Header file for code single-difference observations
0.3.2	...	`CSO`	24.6	Code single-difference observations
0.3.2	...	`PSH`	24.6	Header file for phase single-difference observations
0.3.2	...	`PSO`	24.6	Phase single-difference observations
0.3.2	...	`FCH`	24.6	ASCII image of a header and observation file (code, zero or single differences)
0.3.2	...	`FPO`	24.6	ASCII image of a header and observation file (phase, zero or single differences)
ORBIT files: directory `ORB`				
0.3.3	...	`BRD`	24.7.1	Satellite broadcast messages
0.3.3	...	`PRE`	24.7.2	Precise ephemeris in SP1, SP2, or SP3 format
0.3.3	...	`TAB`	24.7.3	Tabular orbits
0.3.3	...	`STD`	24.7.4	Standard orbits (Bernese orbit representation)
0.3.3	...	`RPR`	24.7.5	Radiation pressure coefficient file
0.3.3	...	`ELE`	24.7.6	Improved orbit parameters (result of an orbit determination)
0.3.3	...	`FSO`	24.7.4	ASCII image of a standard orbit file
0.3.3	...	`FRP`	24.7.5	ASCII image of a radiation pressure coefficient file
MISCELLANEOUS files:				
a) Station related files: directory `STA`				
0.3.4	...	`CRD`	24.8.1	Station coordinates (geocentric)
0.3.4	...	`ECC`	24.8.2	Station eccentricity elements
0.3.4	...	`VEL`	24.8.3	Station velocities
0.3.4	...	`STN`	24.8.4	Station name translation table
0.3.4	...	`HTR`	24.8.27	Antenna height translation table
0.3.4	...	`BLQ`	24.8.28	Ocean loading table
0.3.4	...	`BSL`	24.8.29	Baseline definitions
0.3.4	...	`CLU`	24.8.30	Cluster definitions input
0.3.4	...	`CLB`	24.8.31	Cluster definitions output
0.3.4	...	`FIX`	24.8.32	Special fixed station file
0.3.4	...	`SIG`	24.8.33	Special troposphere file
0.3.4	...	`FTP`	24.8.34	Special station ftp file
0.3.4	...	`AZI`	24.8.35	Antenna orientation file
b) Atmosphere related files: directory `ATM`				
0.3.4	...	`MET`	24.8.19	Meteo or water vapor radiometer data

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Menu	Example file	Ext.	Section	Purpose
0.3.4	...	TRP	24.8.20	Troposphere parameter estimates
0.3.4	...	TRO	24.8.21	Tropospheric SINEX file
0.3.4	...	ION	24.8.22	Ionosphere models
0.3.4	...	INX	24.8.23	Ionosphere (IONEX) maps
c) Orbit related files: directory ORB				
0.3.4	...	CLK	24.8.24	Satellite clocks
0.3.4	...	CLK	24.8.25	Receiver clocks
0.3.4	...	DCB	24.8.26	Differential P1-P2 code biases for satellites and receivers
d) Output files: directory OUT				
0.3.4	...	COV	24.8.5	Covariances (of coordinates or of all parameters)
0.3.4	...	RES	24.8.6	Residuals
0.3.4	...	OUT	24.8.7	Program output
0.3.4	...	NEQ	24.8.8	Normal equations in ADDNEQ format
0.3.4	...	NQO	24.8.9	Normal equations in ADDNEQ2 format
0.3.4	...	LST	24.8.10	Output listing files
0.3.4	...	PLT	24.8.11	Plot files
0.3.4	...	ERP	24.4.7	Earth rotation parameters (Bernese)
0.3.4	...	IEP	24.8.12	IERS format of Earth rotation parameters
0.3.4	...	SNX	24.8.13	SINEX format (coordinates and velocities)
0.3.4	...	WGT	24.8.14	Covariance components, NEQ-scaling file
0.3.4	...	EDT	24.8.15	Observation editing file
0.3.4	...	DEL	24.8.16	List of files to be deleted
0.3.4	...	SUM	24.8.17	Summary output file
0.3.4	...	SMC	24.8.18	CODSPP output summary
0.3.4	...	SME	24.8.18	CODSPP output summary
PROGRAM related files: directory INP or/and SKL				
0.3.1	.....N.	INP*	24.9	Table to access general file names
0.3.1	.....F.	INP*	24.9	File containing list of input file names
0.3.1	.....I.	INP*	24.9	Program options
0.3.1	.....M.	INP*	24.9	File containing list of meteo file names (GPSEST only)
0.3.1	.....T.	SKL	24.9	Text file

* Master copies (skeletons) in directory $X/SKL with extension SKL

Examples for all file types presented in the next sections are available on-line in the directory $X/INX (UNIX) / X:[INX] (VMS) / X:\INX (DOS) usually with the name EXAMPLE.ext (ext is the default extension).

24.4 General Files

The *general files* are important files for the processing part. They are independent from the user and also independent from the campaign processed. The files belonging to this group are stored in the directory GEN of the *Bernese GPS Software* Version 4.2.

24.4.1 Constant File

Type : ASCII

Directory : `$X/GEN` (UNIX) / `X:[GEN]` (VMS) / `X:\GEN` (DOS)

Content : All physical constants used in the program system.

Created by : User-defined.

Used by : Most of the programs.

Example : Figure 24.2. Also available in the distribution.

Further Information :

- The constants refer to the WGS-84 system of constants. Exception is GM, where the value from Laser ranging is used.
- The constant file is read at the beginning of a program and the values are put into the `FORTRAN COMMON/CONST/` (Include file).
- The values for `WGTPHA` and `WGTCOD` are suited to specify the relative weights between phase and pseudo-code observations (if you use both observation types simultaneously in the parameter estimation program GPSEST).
- Carrier frequencies and frequency differences for GLONASS are included.
- `HREF, PREF, TREF`, and `HUMREF` are used for the definition of the a priori troposphere models (option `EXTRAPOLATION` in GPSEST).
- The major constants contained in this file should **not** be changed by the user.

```
GENERAL CONSTANTS FOR BERNESE GPS SOFTWARE VERSION 4.2
------------------------------------------------------

C      =  299792458.D0    VELOCITY OF LIGHT                M/SEC
FREQ1  = 1575420000.D0    L1-CARRIER FREQUENCY   GPS       1/SEC
FREQ2  = 1227600000.D0    L2-CARRIER FREQUENCY   GPS       1/SEC
FREQP  =   10230000.D0    P-CODE     FREQUENCY   GPS       1/SEC
FREQG1 = 1602000000.D0    L1-CARRIER FREQUENCY   GLONASS   1/SEC
FREQG2 = 1246000000.D0    L2-CARRIER FREQUENCY   GLONASS   1/SEC
DFRQG1 =     562500.D0    L1-CARRIER FREQ. DIFF. GLONASS   1/SEC
DFRQG2 =     437500.D0    L2-CARRIER FREQ. DIFF. GLONASS   1/SEC
FREQGP =    5110000.D0    P-CODE     FREQUENCY   GLONASS   1/SEC
GM     = 398.6004415D12   GRAVITY CONSTANT*EARTH MASS      M**3/SEC**2
GMS    = 1.3271250D20     GRAVITY CONSTANT*SOLAR MASS      M**3/SEC**2
GMM    = 4.9027890D12     GRAVITY CONSTANT*LUNAR MASS      M**3/SEC**2
AE     =    6378137.D0    EQUATORIAL RADIUS OF EARTH       M
CONRE  =    6371000.D0    MEAN RADIUS OF THE EARTH         M
FACTEC = 40.3D16          IONOSPHERIC FACTOR               M/SEC**2/TECU
P0     =          -.94D-7 NOMINAL RAD.PR. ACCELERAT.       M/SEC**2
OMEGA  = 7292115.1467D-11 ANGULAR VELOCITY OF EARTH        RAD/SEC
ET-UTC =         55.      EPH. TIME (ET) MINUS UTC         SEC
WGTPHA =          1.D0    WEIGHT FOR PHASE OBSERVATIONS    1
WGTCOD =          1.D-4   WEIGHT FOR CODE OBSERVATIONS     1
HREF   =          0.      REFERENCE HEIGHT FOR METEO MODEL M
PREF   =       1013.25    PRESSURE AT HREF                 MBAR
TREF   =         18.      TEMPERATURE AT HREF              DEG. CELSIUS
HUMREF =         50.      HUMIDITY AT HREF                 %
```

Figure 24.2: File of all physical constants `CONST`.

24.4.2 Geodetic Datum Information

Type : ASCII
Directory : `$X/GEN` (UNIX) / `X:[GEN]` (VMS) / `X:\GEN` (DOS)
Content : Information concerning different geodetic datum definitions.
Created by : User-defined.
Used by : All routines accessing coordinate files.
Example : Figure 24.3. Also available in the distribution.
Further Information : Users may add more geodetic datums. Each coordinate file refers to one of the datums specified in this list. The datum information is only used to compute ellipsoidal coordinates of the sites.

```
LOCAL GEODETIC DATA FOR BERNESE GPS SOFTWARE VERSION 4.2
---------------------------------------------------------
DATUM               ELLIPSOID          SHIFTS (M)         ROTATIONS (")

ITRF97              AE = 6378137.000   DX =      0.0000   RX =    0.0000
                    1/F= 298.2572221   DY =      0.0000   RY =    0.0000
                    SC = 0.00000D+00   DZ =      0.0000   RZ =    0.0000

WGS - 84            AE = 6378137.000   DX =      0.0000   RX =    0.0000
                    1/F= 298.2572236   DY =      0.0000   RY =    0.0000
                    SC = 0.00000D+00   DZ =      0.0000   RZ =    0.0000

GRS - 80            AE = 6378137.000   DX =      0.0000   RX =    0.0000
                    1/F= 298.2572221   DY =      0.0000   RY =    0.0000
                    SC = 0.00000D+00   DZ =      0.0000   RZ =    0.0000

CH - 1903           AE = 6377397.200   DX =    679.0000   RX =    0.0000
                    1/F= 299.1528000   DY =     -2.0000   RY =    0.0000
                    SC = 0.00000D+00   DZ =    404.0000   RZ =    0.0000

PZ - 90             AE = 6378137.000   DX =      0.0000   RX =    0.0000
                    1/F= 298.2572236   DY =      0.0000   RY =    0.0000
                    SC = 0.00000D+00   DZ =      0.0000   RZ =   -0.3345
```

Figure 24.3: File of the geodetic datum definitions `DATUM`.

24.4.3 Receiver Characterization File

Type : ASCII
Directory : `$X/GEN` (UNIX) / `X:[GEN]` (VMS) / `X:\GEN` (DOS)
Content : Characteristics of different receiver types.
Created by : User-defined.
Used by : Programs GPSSIM (no menu support) and BV3RXO (Menu 2.6.1).
Example : Figure 24.4. Also available in the distribution.
Further Information : The antenna phase center offsets in this file are no longer used because these values are taken from the antenna phase center eccentricity file (see Section 24.4.5). Only the programs GPSSIM (simulation of GPS observations) and BV3RXO (conversion of Bernese observation files to RINEX) use the file to obtain information concerning the observation types and frequencies collected by a specific receiver.

```
GPS RECEIVER INFORMATION BERNESE GPS SOFTWARE VERSION 4.2
---------------------------------------------------------

RECEIVER TYPE    #FREQ  CODE  FREQ  WAVE.F.  ANT.ECCENTRIC.(N,E,U)(M)
****************   *     **    L*:     *      **.**** **.**** **.****

TI-4100            2     P     L1:     1       0.0000  0.0000  0.2270
                         P     L2:     1       0.0000  0.0000  0.2020

ROGUE              2     P     L1:     1       0.0000  0.0000  0.0000
                         P     L2:     1       0.0000  0.0000  0.0000

ASHTEC             1     CA    L1:     1       0.0000  0.0000  0.0000

WM102              2     CA    L1:     1       0.0000  0.0000  0.0000
                         P     L2:     1       0.0000  0.0000  0.0000

TRIMBLE 4000SSE    2     CA    L1:     1       0.0000  0.0000  0.0692
                         P     L2:     2       0.0000  0.0000  0.0677

MINIMAC            2     CA    L1:     1       0.0000  0.0000  0.0000
                               L2:     2       0.0000  0.0000  0.0000

SIMULA             2     P     L1:     1       0.0000  0.0000  0.0000
                         P     L2:     1       0.0000  0.0000  0.0000

SR299              2     CA    L1:     1       0.0000  0.0000  0.0000
                         P     L2:     1       0.0000  0.0000  0.0000


*) ANTENNA ECCENTRICITIES MEASURED FROM BOTTOM OF GROUND PLATE TO
   L1/L2 PHASE CENTER
```

Figure 24.4: Receiver characterization file `RECEIVER.`

24.4.4 Receiver/Antenna Name Translation File

Type : ASCII

Directory : `$X/GEN` (UNIX) / `X:[GEN]` (VMS) / `X:\GEN` (DOS)

Content : Receiver/antenna name translation file.

Created by : User-defined, assistance using Menu 1.4.5.

Used by : Program RXOBV3 (Menu 2.7.1).

Example : Figure 24.5. Also available in the distribution. Updated files for IGS sites are available in the anonymous CODE ftp area (see Section 7.4).

Further Information : This translation table may be used in the transformation program RXOBV3 to make sure that a unique and well-defined set of receiver and antenna names is used in the *Bernese GPS Software*. This is important because of the "antenna phase center offset" file (see Section 24.4.5), where antenna phase center values have to be defined for each receiver/antenna pair. If the file name of such a translation file is specified in Menu 2.7.1 (option `RCVR / ANTENNA`) all receiver/antenna names found in the RINEX observation files will be translated according to the translation table.

Please note, that in our example (Figures 24.6 and 24.7) the translation is station-dependent (warning, if the specified translation does not match with the given station name) and therefore fully dependent on the sites of a campaign. If you specify no special station names (the original intention

of this file) the translations will be performed independently of the station names.
Note: Wildcards (*,?) are also allowed in the fields OLD RECEIV. TYPE and OLD ANTENNA TYPE.

```
RECEIVER AND ANTENNA TYPE TRANS. TABLE FOR JAN93 CAMPAIGN         1-JUL-93 15:40
------------------------------------------------------------------------------

OLD RECEIV. TYPE  OLD ANTENNA TYPE  NEW RECEIV. TYPE  NEW ANTENNA TYPE  STATION NAME

ROGUE SNR-8       DORNE MARGOLIN B  ROGUE SNR-8       DORNE MARGOLIN B  MATE 12734M008
ROGUE SNR-8       DORNE MARGOLIN B  ROGUE SNR-8       DORNE MARGOLIN B  TROM 10302M003
ROGUE SNR-800     DORNE MARGOLIN B  ROGUE SNR-800     DORNE MARGOLIN B  WETT 14201M009
ROGUE SNR-800     DORNE MARGOLIN B  ROGUE SNR-800     DORNE MARGOLIN B  TAIW 23601M001
ROGUE SNR-8C      DORNE MARGOLIN B  ROGUE SNR-8C      DORNE MARGOLIN B  GRAZ 11001M002
ROGUE SNR-8000    DORNE MARGOLIN T  ROGUE SNR-8000    DORNE MARGOLIN T  GRAZ 11001M002B
ROGUE SNR-8C      DORNE MARGOLIN B  ROGUE SNR-8C      DORNE MARGOLIN B  HERS 13212M007
ROGUE SNR-8000    DORNE MARGOLIN R  ROGUE SNR-8000    DORNE MARGOLIN R  MCMU 66001S006
ROGUE SNR-8100    DORNE MARGOLIN T  ROGUE SNR-8100    DORNE MARGOLIN T  NOTO 12717M003
ROGUE SNR-8100    DORNE MARGOLIN T  ROGUE SNR-8100    DORNE MARGOLIN T  MATE 12734M008B
ROGUE SNR-12 RM   DORNE MARGOLIN B  ROGUE SNR-12 RM   DORNE MARGOLIN B  KOSG 13504M003
ROGUE SNR-12 RM   DORNE MARGOLIN T  ROGUE SNR-12 RM   DORNE MARGOLIN T  THU1 43001M001
ROGUE SNR-12 RM   DORNE MARGOLIN T  ROGUE SNR-12 RM   DORNE MARGOLIN T  MASP 31303M002C
TRIMBLE 4000SSE   4000ST L1/L2 GEO  TRIMBLE 4000SSE   4000ST L1/L2 GEO  ZIMM 14001M004
ASHTECH Z-XII3    DORNE MARGOLIN T  ASHTECH Z-XII3    DORNE MARGOLIN T  LAMA 12209M001
ASHTECH L-XII     ASHTECH L-XII     ASHTECH L-XII     MARINE/RANGE
ASHTECH Z-XII3    GEODETIC L1/L2 P  ASHTECH Z-XII3    GEODETIC L1/L2 P
ASHTECH Z-XII3    GEODETIC L1/L2 L  ASHTECH Z-XII3    GEODETIC L1/L2 L
*4000*SSE         *4000*SSE         TRIMBLE 4000SSE   4000ST L1/L2 GEO
*4000*SSE         *GEODETIC*        TRIMBLE 4000SSE   4000ST L1/L2 GEO
```

Figure 24.5: Receiver/antenna name translation (.TRN) file.

24.4.5 Antenna Phase Center Offsets and Patterns

Type : ASCII

Directory : $X/GEN (UNIX) / X:[GEN] (VMS) / X:\GEN (DOS)

Content : Antenna phase center offsets and variations.

Created by : User-defined.

Used by : All programs processing GPS observations.

Example : Figures 24.6 and 24.7 show an example using format 2 (formats are explained at the bottom of Figure 24.6). An updated version of the file PHAS_IGS.01 is available at the anonymous CODE ftp area (see Section 7.4).

Further Information :

- It is possible to define different phase center locations for each individual receiver/antenna.
- Elevation-dependent antenna phase center corrections are of importance for the combination of different antenna pairs in the network. Between TRIMBLE and ROGUE antennas the effect of non-modeled elevation-dependent variations may reach more than 10 cm in station height [*Rothacher et al.*, 1996*b*]. At present (January 2001) the recommended values to be used in the processing is the model IGS_01 [*Rothacher*, 1996]. These values were obtained from

a combination of the results of several antenna test campaigns (estimated from the GPS data with given ground truth) [*Rothacher et al.*, 1995*b*], [*Rothacher*, 1996].

- For details concerning the estimation of elevation- (and azimuth-) dependent antenna phase center variations see Chapter 17.
- Please note the different formats: "0" means no elevation dependent corrections, "1" means elevation dependent values given to the right of the offset values, and "2" means *phase center maps (grid)* or *spherical harmonics* available. An example of elevation- and azimuth-dependent grid information is shown in Figure 24.7.
- Starting from GPS week 1017 (July 1999), a new IGS naming convention for receiver and antenna names was introduced. A list of the currently valid receiver and antenna names may be found at `ftp://igscb.jpl.nasa.gov/igscb/station/general/`.

```
 RECEIVER ANTENNA PHASE CENTER OFFSETS AND VARIATIONS                  2-OCT-99
 ---------------------------------------------------------------------------------------------------------------------------

 RECEIVER TYPE          ANTENNA S/N  FREQ  PHASE CENTER OFFSETS (M)           ELEVATION DEPENDENCE OF PHASE CENTER (MM)
 ANTENNA  TYPE          FROM    TO    L*    NORTH    EAST     UP    FMT   90 85 80 75 70 65 60 55 50 45 40 35 30 25 20 15 10 05 00
 ********************  ****** ******   *   **.**** **.**** **.****   *    ** ** ** ** ** ** ** ** ** ** ** ** ** ** ** ** ** ** **

 ROGUE SNR-800             0 999999   1    0.0000  0.0000  0.0780   0
 DORNE MARGOLIN B                     2    0.0000  0.0000  0.0960

 ROGUE SNR-8000            0 999999   1    0.0000  0.0000  0.1100   0
 DORNE MARGOLIN T                     2    0.0000  0.0000  0.1280

 TRIMBLE 4000SSI           0 999999   1    0.0015 -0.0012  0.0751   2
 TR GEOD L1/L2 GP                     2   -0.0011  0.0017  0.0692

 TRIMBLE 4000SSE           0 999999   1    0.0000  0.0000  0.0796   2
 M-PULSE L1/L2 SURVEY                 2    0.0000  0.0000  0.0932

 ASHTECH XII3              0 999999   1    0.0005  0.0003  0.0799   2
GEODETIC L1/L2 L                      2   -0.0012  0.0008  0.0792

SR299                      0 999999   1    0.0031 -0.0002  0.1131   2
INTERNAL                              2    0.0013 -0.0035  0.1172

SR299E                     0 999999   1    0.0048  0.0019  0.0492   2
EXTERNAL WITH GP                      2    0.0034 -0.0052  0.0418

MACROMETER                 0 999999   1    0.0022 -0.0082  0.1631   2
MACROMETER X-DIPOLE                   2    0.0043  0.0020  0.0913

TOPCON                     0 999999   1   -0.0039  0.0073  0.1471   2
72110                                 2   -0.0044  0.0065  0.1278

SIMULA                     0 999999   1    0.0000  0.0000  0.0000   2
SIMULA                                2    0.0000  0.0000  0.0000

FORMAT INDICATOR:
  FMT=0 :  ONLY PHASE CENTER OFFSETS ARE USED
  FMT=1 :  ZENITH DEPENDENT CORRECTIONS GIVEN TO THE RIGHT OF THE OFFSET
           VALUES ARE USED
  FMT=2 :  PHASE CENTER MAPS OR SPHERICAL HARMONICS ARE USED (ZENITH/AZIMUTH
           DEPENDENT)
ANTENNA PHASE CENTER OFFSETS MEASURED FROM ANTENNA REFERENCE POINT (ARP)
TO THE MEAN L1/L2 PHASE CENTER.
```

Figure 24.6: Antenna phase center offsets model `IGS_01` (file `PHAS_IGS.01`, part 1).

```
PHASE CENTER MAPS AND/OR COEFFICIENTS OF SPHERICAL HARMONICS IN MILLIMETERS:
-------------------------------------------------------------------------

TYPE 1 :  ELEVATION/AZIMUTH GRID
TYPE 2 :  SPHERICAL HARMONICS COEFFICIENTS (UNNORMALIZED)
TYPE 3 :  SPHERICAL HARMONICS COEFFICIENTS (NORMALIZED)

D(Z)   :  ZENITH  TABULAR INTERVAL (DEGREES)
D(A)   :  AZIMUTH TABULAR INTERVAL (DEGREES)
N(Z)   :  DEGREE OF SPHERICAL HARMONICS DEVELOPMENT
N(A)   :  ORDER  OF SPHERICAL HARMONICS DEVELOPMENT

RECEIVER TYPE        ANTENNA TYPE         FROM   TO      TYP   D(Z) D(A)
******************** ******************** ****** ******  ***    ***  ***
TRIMBLE 4000SSI      TR GEOD L1/L2 GP          0 999999    1      5  360

    A\Z     0      5     10     15     20     25     30     35     40     45     50     55     60     65     70     75     80     85     90
L1   0   0.00   1.80   4.60   8.10  11.70  14.50  16.10  16.90  16.90  16.20  14.90  13.40  11.90  10.40   9.00   7.90   8.20   0.00   0.00
L2   0   0.00   0.30   0.90   1.80   3.00   4.10   4.90   5.40   5.60   5.60   5.30   4.50   3.60   2.80   2.10   1.20   0.10   0.00   0.00

.................................

RECEIVER TYPE        ANTENNA TYPE         FROM   TO      TYP   D(Z) D(A)
******************** ******************** ****** ******  ***    ***  ***
SIMULA               SIMULA                    0  99999    1      5   45

    A\Z     0      5     10     15     20     25     30     35     40     45     50     55     60     65     70     75     80     85     90
L1   0   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00
L2   0   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00
L1  45   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00
L2  45   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00
L1  90   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00
L2  90   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00
L1 135   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00
L2 135   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00
L1 180   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00
L2 180   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00
L1 225   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00
L2 225   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00
L1 270   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00
L2 270   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00
L1 315   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00
L2 315   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00
L1 360   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00
L2 360   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00
```

Figure 24.7: Elevation and azimuth dependence of the antenna phase centers according to model `IGS_01` (file `PHAS_IGS.01`, part 2).

24.4.6 Geopotential Coefficients

Type : ASCII

Directory : `$X/GEN` (UNIX) / `X:[GEN]` (VMS) / `X:\GEN` (DOS)

Content : Earth potential coefficients.

Created by : User-defined.

Used by : Program ORBGEN.

Example : Figure 24.8. Also available in the distribution.

Further Information : The `GEMT3`, `GEM10N`, and `JGM3` coefficients are included in the distribution. The user of Version 4.2 should use the `JGM3` model. As an example we include here a part of the `JGM3` model. The file is read by the subroutine `GETPOT` in the form

```
READ(LFN...,...) SCRATCH,N,M,C,S
```

where N is the zonal, M is the tesseral index, C is the C(N,M), S is the S(N,M) coefficient.

```
  JGM-3
 (2A10,2E20.10)                                              J2-DOT = -26x10-12
JGM-3                   398600.44150E+09          6378136.30              1986.0
 (A6,2I2,2D21.14,2D12.4,F4.0)
RECOEF 2 1-0.18698764000000E-09 0.11952801000000E-08  0.0000E+00  0.0000E+00-1.
GEOCOE 2 0-0.484169548456 47E-03 0.00000000000000E+00  0.4660E-10  0.0000E+00-1.
GEOCOE 3 0 0.95717059088800E-06 0.00000000000000E+00  0.3599E-10  0.0000E+00-1.
GEOCOE 4 0 0.53977706835730E-06 0.00000000000000E+00  0.1339E-09  0.0000E+00-1.
......
GEOCOE 3 1 0.20301372055530E-05 0.24813079825561E-06  0.1153E-09  0.1152E-09-1.
GEOCOE 4 1-0.536243554298 51E-06-0.47377237061597E-06  0.8693E-10  0.8734E-10-1.
GEOCOE 5 1-0.62727369697705E-07-0.94194632134383E-07  0.2466E-09  0.2465E-09-1.
GEOCOE 6 1-0.76103580407274E-07 0.26899818932629E-07  0.2702E-09  0.2752E-09-1.
```

Figure 24.8: The geopotential file `JGM3`.

24.4.7 Pole Coordinates

Type : ASCII

Directory : `$X/GEN` (UNIX) / `X:[GEN]` (VMS) / `X:\GEN` (DOS) as input files or in the campaign-specific directory `OUT` as output files.

Content : Pole coordinates, UT1-UTC, UTC-GPS.

Created by : Download from Berne anonymous account (`C04_yyyy.ERP`) in Bernese ERP format (see Section 7.4) or download from different places (C04 pole, rapid pole, IGS pole) and use Menu 5.5.1 to transform to Bernese ERP format (currently 13 different pole formats are supported). The pole file may also be created as a result of a parameter estimation using programs GPSEST or ADDNEQ/`ADDNEQ2`.

Used by : All orbit programs and all processing programs.

Example : Figure 24.9.

Further Information :

- ERP files are input files for most of the programs (Menu 0.3.1 , directory GEN) but they may also be created as output files using GPSEST or ADDNEQ/ADDNEQ2 (Menu 0.3.4 extension selection).
- The subdaily Earth rotation model RAY is available in Version 4.2. Available nutation models are NO (default) and for special tests also OBSERVED and HERRING
- The pole file is accessed by the subroutine GETPOL. It is not important that the pole positions are given at equidistant time intervals. GETPOL checks, however, for each request that the spacing between the two data points used for interpolation is smaller than 10 days. The table values are linearly interpolated and a warning is given if a leap second occurred in the interpolation interval.

24.4.8 Pole Offsets for the C04 and Rapid Pole Series

Type : ASCII

Directory : $X/GEN (UNIX) / X:[GEN] (VMS) / X:\GEN (DOS)

Content : Pole Offsets for the C04 combined pole series (the C04 pole series is based on a reference system different from the ITRF realizations).

Created by : User-defined. Transformation parameters obtained from the IERS annual reports (usually Table II-3).

Used by : POLUPD (Menu 5.5.1).

Example : Figure 24.10.

Further Information : If no file is specified in Menu 0.3.1 no offsets are applied. Updated pole files are available in Berne, so that format conversion and transformation are not necessary (see Section 7.4).

24.4.9 SINEX General Information File

Type : ASCII

Directory : $X/GEN (UNIX) / X:[GEN] (VMS) / X:\GEN (DOS)

Content : General information file to be included in SINEX output files (see Sections 7.3 and 18.4).

```
IERS C04 POLE                                                    17-AUG-00 21:01
--------------------------------------------------------------------------------
CELESTIAL POLE OFFSET: NO                        SUBDAILY POLE MODEL: RAY
    DATE   TIME   X-POLE   Y-POLE   UT1-UTC GPS-UTC    RMS XP  RMS YP   RMS DT
YYYY MM DD HH MM    (")      (")      (S)     (S) REM     (")     (")      (S)

2000  1  1  0  0  0.04320  0.37769  0.355504  13. C04  0.00000 0.00000 0.000000
2000  1  2  0  0  0.04348  0.37750  0.354634  13. C04  0.00000 0.00000 0.000000
....
2000  8 16  0  0  0.07198  0.24417  0.199849  13. C04  0.00000 0.00000 0.000000
2000  8 17  0  0  0.07123  0.24387  0.199620  13. C04  0.00000 0.00000 0.000000
```

Figure 24.9: Pole file (.ERP) in Bernese Format.

Created by : User-defined.

Used by : ADDNEQ (Menu 4.8.1)and `ADDNEQ2` to include general information into the SINEX files.

Example : Figure 24.11.

Further Information : If no file is specified in Menu 0.3.1 no information concerning your institution is included in the SINEX file (not-given fields (`---`) are used instead). If you want to generate SINEX result files to be exchanged with other institutions, modify this file to contain information concerning your institute.

24.4.10 IONEX General Information File

Type : ASCII

Directory : `$X/GEN` (UNIX) / `X:[GEN]` (VMS) / `X:\GEN` (DOS)

Content : General information file to be included in IONEX output files (see Chapter 13).

Created by : User-defined.

Used by : GPSEST (Menu 4.5) and IONINX to include general information into the IONEX files.

Example : Figure 24.12. Note that this figure shows only the first part of the example file `X:/GEN/IONEX.`

Further Information : You have to adjust and complete this file as soon as you want to create ionosphere map files in IONEX format (see Section 24.8.23). We recommend you to copy the example file `X:/GEN/IONEX.` to, e. g., `X:/GEN/IONEX.USR` and to edit the last-mentioned file. This file does not only contain "auxiliary" text information to be included in IONEX files but also important specifications to be defined by the user. This is the reason why this file is usually addressed as "IONEX control file". Let us briefly highlight all entries:

(1) "`SATELLITE SYSTEM`", the satellite system used, e. g., GPS, GLONASS, or GNSS.
(2) "`AGENCY`", the agency creating the IONEX file, e. g., AIUB.
(3) "`MULTI-LINE DESCRIPTION`" is intended for a brief description of the technique used to derive the TEC data provided. A contact address is desirable.

```
POLE OFFSET COEFFICIENTS IERS EOP SERIES - IERS REFERENCE FRAMES
--------------------------------------------------------------------------------
REFERENCE TIME (YYYY MM DD HH.H): 1988 00 00 00.0

      X    RMSX    Y    RMSY   UT1   RMSU  DPSI   RMS   DEPSI  RMS
     MAS   MAS    MAS   MAS   0.1MS  0.1MS  MAS   MAS    MAS   MAS
**  *****  ****  *****  ****  *****  ****  *****  ****  *****  ****
A   -0.10  0.40   0.70  0.40  -0.60  0.20  -0.20  0.01   0.30  0.01
A'   0.08  0.04   0.15  0.04   0.04  0.03   0.00  0.00   0.00  0.00
```

Figure 24.10: Pole offset file in Bernese format. The values are valid for the transformation of the C04 pole to the ITRF94 realization of the terrestrial reference frame.

(4) "OBSERVABLES USED", one-line specification of the observable(s) used in the TEC computation.
(5) "MULTI-LINE COMMENT", additional comment lines.
(6) "DCB COMMENT", DCB-related comment line (one line only).
(7) "INFORMATION TO BE SAVED": Here you may specify whether "TEC MAPS" (TEC values), "RMS MAPS" (rms errors), "DIFFERENTIAL CODE BIASES" (DCB estimates for the GPS/GLONASS satellites) are requested to be included in the IONEX file. The entry "DEFAULT EXPONENT" defines in which unit the TEC and rms values are given in the IONEX file. With "-1", the *recommended* value, these values are given in units of 0.1 TECU.
(8) At "REQUESTED SNAPSHOTS", you may define for which times TEC maps (snapshots) should be computed and written to the IONEX file. Using "12 00 00", "12 00 00", "86400", you would get a single snapshot at 12:00:00 UT. An other setting might be: "01 00 00", "23 00 00", "7200". This would lead to 12 2-hourly snapshots, namely at 01:00:00, 03:00:00, 05:00:00, ..., 23:00:00 UT.
(9) At "DATA GRID", you have to define the geographical area and the spatial resolution of the grid where TEC and rms values are probed. Note that the current setting is suited for global TEC maps, but *not* for regional maps.

```
SINEX : OPTION INPUT FILE                                    8-Jun-00 19:14
-------------------------------------------------------------------------------
(REMARK: YES=1,NO=0 ; 2 EMPTY LINES AFTER EVERY INPUT GROUP)

AGENCY:
-------

       ***
--> :  COD


DATA :
------

       ***
--> :  COD


HEADER INFORMATION TO BE INCLUDED:
----------------------------------

+FILE/REFERENCE
 DESCRIPTION        CODE coordinate and velocity results in SINEX format V1.00
 OUTPUT             University of Berne
 CONTACT            urs.hugentobler@aiub.unibe.ch
 SOFTWARE           Bernese GPS Software V4.3
 HARDWARE           SunOS R5.6
 INPUT              CODE
-FILE/REFERENCE
*-------------------------------------------------------------------------------
+FILE/COMMENT
-FILE/COMMENT
*-------------------------------------------------------------------------------
+INPUT/ACKNOWLEDGMENTS
*AGY DESCRIPTION_____________________________________________________________
 CODE, Center for Orbit Determination in Europe, University of Berne
-INPUT/ACKNOWLEDGMENTS
```

Figure 24.11: General SINEX information file SINEX.

(10) Under "ADDITIONAL OPTIONS", you might define (a) a "minimum TEC value" (TEC values below this threshold are set to this value), (b) a "maximum rms value" (TEC values with larger rms errors are considered as unavailable), and (c) a "scaling factor for rms values" to scale (multiply) the rms errors obtained by the least-squares adjustment. Since *negative* TEC is physically impossible, a threshold value of 0 TECU would make sense at (a).

Nevertheless, we advise the interested user to study the IONEX format specifications [*Schaer et al.*, 1998] and to have a look at CODE's ionosphere-related web site `http://www.aiub.unibe.ch/ionosphere.html` [*Schaer*, 1998].

```
IONEX CONTROL FILE                                        09-SEP-97 00:00
-------------------------------------------------------------------------
(REMARK: YES=1,NO=0 ; 2 EMPTY LINES AFTER EVERY INPUT GROUP)

SATELLITE SYSTEM:
----------------
      ********************
--> : GPS


AGENCY:
------
      ********************
--> :


MULTI-LINE DESCRIPTION (UP TO 12 LINES):
---------------------------------------
      ************************************************************
--> :


OBSERVABLES USED:
----------------
      ************************************************************
--> :


MULTI-LINE COMMENT (UP TO 12 LINES):
-----------------------------------
      ************************************************************
--> : TEC/RMS values in 0.1 TECU; 9999, if no value available


DCB COMMENT:
-----------
      ************************************************************
--> : DCB values in ns


...
```

Figure 24.12: General IONEX information file `IONEX`.

24.4.11 Satellite Information File

Type : ASCII

Directory : `$X/GEN` (UNIX) / `X:[GEN]` (VMS) / `X:\GEN` (DOS)

Content : Satellite information (block, antenna offsets, masses) for GPS (PRN < 100) and GLONASS (PRN > 100).

Created by : User-defined.

Used by : Most orbit and processing programs.

Example : Figure 24.13. Also available in the distribution. In addition the file `SATELLIT.OLD` (old Version 3.5 file in the new format) is also included in the distribution. Other files (with the extension `.ZZZ`, `.SSS`) are available on request to realize a different a priori radiation model. The difference of these files is of importance only for orbit determination purposes of highest quality. Please use the file `SATELLIT.TTT`.

Further Information : The satellite information file contains the block numbers, the masses, the antenna offsets, the Laser retroreflector offsets for the satellites equipped for SLR, the frequency indices for GLONASS satellites, a priori values for the direct radiation pressure coefficients (corrections to ROCK4/42 model) and for the y-biases, and a time window of validity. The mentioned files contain furthermore information concerning the radiation pressure model to be used. We recommend to use the T model as a priori model, even if the differences to the other models is negligible for the creation of the standard orbits from tabular / precise orbits. If a new satellite is launched the information for this new satellite has to be included into the file. It is sufficient in this case to copy a line referring to a satellite of the same block and to modify it for the new satellite (the antenna offsets have to be correct). An up-to-date `SATELLIT.TTT` file may be downloaded from the anonymous BSWUSER ftp area (see Section 7.4).

24.4.12 Satellite Problem File

Type : ASCII

Directory : `$X/GEN` (UNIX) / `X:[GEN]` (VMS) / `X:\GEN` (DOS)

Content : Problems with satellites (maneuvers, bad data).

Created by : User-defined.

Used by : Most orbit and processing programs.

Example : Figure 24.14. Also available in the distribution.

Further Information :

- We recommend to use the updated files (file name characterized by the year) from the anonymous BSWUSER ftp area (see Section 7.4). By specifying this file in the Panel 0.3.1 you avoid many troubles related with problem satellites. All programs that allow for a satellite problem file will automatically use this file if specified in Menu 0.3.1.

```
 SATELLITE SPECIFIC DATA INCLUDING GLONASS !                          2-JUL-00
------------------------------------------------------------------------------
RADIATION PRESSURE MODEL : T980301    (ROCK MODEL T, FLIEGEL ET AL, 1992)

     BLOCK    ANTENNA OFFSETS (M)     MASS      DP0      P2     ROCK MODEL         SLR OFFSETS (M)    IFRQ      START TIME          END TIME
PRN   NO.     DX      DY      DZ      (KG)    (1.E-8)  (1.E-9)   (T=1,S=2)       DX      DY      DZ         YYYY MM DD HH MM SS  YYYY MM DD HH MM SS

  1    3    0.2794  0.0000  1.0230    975.    -0.1088   0.7458      1  0.0000                              0   1990 01 01 00 00 00  2099 12 31 23 59 59
  2    2    0.2794  0.0000  1.0230    880.    -0.0373   0.6362      1  0.0000                              0   1990 01 01 00 00 00  2099 12 31 23 59 59
  3    3    0.2794  0.0000  1.0230    975.    -0.0395   0.5637      1  0.0000                              0   1990 01 01 00 00 00  2099 12 31 23 59 59
  4    3    0.2794  0.0000  1.0230    975.    -0.0502   0.7856      1  0.0000                              0   1990 01 01 00 00 00  2099 12 31 23 59 59
  5    3    0.2794  0.0000  1.0230    975.    -0.0414   0.7612      1  0.0000  0.8626 -0.5245  0.6584      0   1990 01 01 00 00 00  2099 12 31 23 59 59
  6    3    0.2794  0.0000  1.0230    975.    -0.0354   0.7589      1  0.0000  0.8626 -0.5245  0.6584      0   1990 01 01 00 00 00  2099 12 31 23 59 59
  7    3    0.2794  0.0000  1.0230    975.    -0.0238   1.0376      1  0.0000                              0   1990 01 01 00 00 00  2099 12 31 23 59 59
  8    3    0.2794  0.0000  1.0230    975.    -0.0238   1.0000      1  0.0000                              0   1990 01 01 00 00 00  2099 12 31 23 59 59
  9    3    0.2794  0.0000  1.0230    975.    -0.0317   0.7955      1  0.0000                              0   1990 01 01 00 00 00  2099 12 31 23 59 59
 10    3    0.2794  0.0000  1.0230    975.     0.0454   0.7819      1  0.0000                              0   1990 01 01 00 00 00  2099 12 31 23 59 59
 11    4    0.0000  0.0000  0.0000   1100.     0.0000   0.0000      1  0.0000                              0   1999 10 01 00 00 00  2099 12 31 23 59 59
 12    1    0.2100  0.0000  0.8540    519.8    0.0475   0.1326      1  0.0000                              0   1990 01 01 00 00 00  2099 12 31 23 59 59
 13    4    0.0000  0.0000  0.0000   1100.    -0.0599  -0.2801      1  0.0000                              0   1990 01 01 00 00 00  2099 12 31 23 59 59
 14    2    0.2794  0.0000  1.0230    880.    -0.0290   0.9064      1  0.0000                              0   1990 01 01 00 00 00  2099 12 31 23 59 59
....
101    1    0.0000  0.0000  0.0000    900.     0.0000   0.0000      0  0.0000  0.0     0.0     1.510   23   1996 01 01 00 00 00  1996 12 21 23 59 59
101    1    0.0000  0.0000  0.0000    900.     0.0000   0.0000      0  0.0000  0.0     0.0     1.510    2   1999 01 01 00 00 00  2099 12 21 23 59 59
102    1    0.0000  0.0000  0.0000    900.     0.0000   0.0000      0  0.0000  0.0     0.0     1.510    5   1996 01 01 00 00 00  1997 08 23 23 59 59
....

BLOCK NUMBER: BLOCK I   = 1,
              BLOCK II  = 2,
              BLOCK IIA = 3,
              BLOCK IIR = 4,
              BLOCK IIF = 5

SATELLITES ALREADY OUT OF WORK, DO NOT DELETE THESE LINES
 3    1    0.2100  0.0000  0.8540    521.8    0.1788   0.2655      1    off
 6    1    0.2100  0.0000  0.8540    453.8    0.0000   0.0000  *)  1    off
 8    1    0.2100  0.0000  0.8540    440.9    0.0000   0.0000  *)  1    off
....

*) NO INFORMATION AVAILABLE FOR THESE BLOCK I SATELLITES (OUT OF OPERATION
   PRIOR TO THE START OF THE IGS).
```

Figure 24.13: Satellite information file `SATELLITE.TTT` (T means: ROCK Model T to be used as a priori radiation pressure model).

- The satellite problem file invokes the handling of the following problems:

  (1) maneuver epochs (problem 0)

  (2) satellite modeling (problem 4)

  (3) time intervals with bad data (phase/code) for specific satellites (problems 1, 2, 3)

  A *maneuver* is usually detected by BRDTST because of drastic changes in the orbital elements of the broadcast ephemerides. BRDTST (Menu 3.1.2) creates a new satellite number for the maneuver satellite after the event. The new number is equal to the old satellite number + 50. All broadcast messages after the event are related to the new satellite number. Programs BRDTAB (Menu 3.2) and ORBGEN (Menu 3.3) treat the "new" satellite as any other satellite. The satellite SVN+50 is only present in the orbit files, but not in the observation files. An approximate time for the maneuver may be retrieved from the BRDTST output file. A more precise epoch may be obtained by looking at the residuals of CODSPP (Menu 4.2) for this satellite. Even if the maneuver time may be determined quite accurately (the residuals of MAUPRP (Menu 4.4.2) may be used for refinements) it may be necessary to delete observations around the maneuver epoch because the satellite may behave in an unpredictable way around this epoch (the first few minutes or even hours). The maneuver time has to be introduced into the satellite problem file. The processing programs will read this file and use the orbit of satellite SVN or SVN+50 depending on whether the epoch lies before or past the maneuver time. For maneuvers the action number is always 0.

  The problem type *satellite modeling* is used for long-arc computations using program ADDNEQ (Menu 4.8.1) or ADDNEQ2 (Menu 4.8.3). This problem type indicates to set up a new arc (action 0) for the specified satellite at the specified time (only arc boundaries are allowed).

  The problem type *bad satellite* is used to exclude data stemming from a particular satellite from the processing. If you specify this file in RXOBV3 (Menu 2.7.1) you have the possibility to transfer them to the Bernese formats as marked observations (action item 1) or to remove them (action item 2; not transferred to the Bernese-specific format). The remove action is supported only in program RXOBV3.
  For program CODSPP (Menu 4.2) the presence of this file means not to use the pseudorange data (problem 2 or 3, action 1) for the estimation of the receiver clock corrections. To assume that the pseudorange observations of a certain satellite are bad, but that the corresponding phase observations are good may be true in some cases. It may be better to mark both, pseudorange and phase observations, to avoid problems in the next processing steps.

To use this file in the program MAUPRP (Menu 4.4.2) means that the phase data are marked (problem 1 or 3, action 1). Please note: If you use the file in the program GPSEST (Menu 4.5) you exclude the corresponding observations from the parameter estimation without having to mark them with the program SATMRK (Menu 5.1). The observations are not marked in the observation files, however. When marked with SATMRK it is impossible to reset the marked observations without also resetting the marks set by the preprocessing programs or the SATMRK options. *With the satellite problem file on the other hand, data can easily be excluded for any satellite and time interval in* GPSEST *without any consequences for future program runs.*

```
SATELLITE PROBLEMS: MANOEUVRES OR BAD OBSERVATION INTERVALS           15-JAN-95
------------------------------------------------------------------------------

SATELLITE  PROBLEM    ACTION           FROM                  TO
   **         *         *       YYYY MM DD HH MM SS  YYYY MM DD HH MM SS

   24         3         1       1996  1  8 00 00 00  1996  1  9 24 00 00
   24         0         0       1996  1  8 12 00 00
   16         3         1       1996  2  6 00 00 00  1996  2  6 24 00 00
   16         0         0       1996  2  6 12 00 00
   12         3         1       1996  2  8 00 00 00  1996  2  8 24 00 00
   16         4         0       1996  2 17 00 00 00
   16         4         0       1996  2 18 00 00 00
   ...
   14         4         0       1996  7 15 00 00 00
   14         3         2       1996  7 16 00 00 00  1996  7 16 24 00 00
   14         0         0       1996  7 16 12 00 00
   16         4         0       1996  7 17 00 00 00
   16         4         0       1996  7 18 00 00 00
   19         4         0       1996  7 20 00 00 00
   19         4         0       1996  7 21 00 00 00
   20         3         2       1996  7  2 00 00 00  1996 12 31 24 00 00

PROBLEM DESCRIPTION    PROBLEM          ACTION DESCRIPTION          ACTION
-------------------    -------          ------------------          ------

SATELLITE MANOEUVRE        0            SET UP SAT. WITH SVN=SVN+50    0
SATELLITE MODELLING        4            SPLIT UP ARCS IN ADDNEQ        0
BAD PHASE DATA             1            MARK PHASE OBSERVATION         1
BAD PHASE DATA             1            REMOVE PHASE OBSERVATION       2
BAD CODE DATA              2            MARK CODE OBSERVATIONS         1
BAD CODE DATA              2            REMOVE CODE OBSERVATIONS       2
BAD PHASE AND CODE DATA    3            MARK BOTH OBSERVATION TYPES    1
BAD PHASE AND CODE DATA    3            REMOVE BOTH OBSERVATION TYPES  2
```

Figure 24.14: Satellite problem file (example file `SAT_1996.CRX`). The files SAT_yyyy.CRX are available in the anonymous FTP area in Berne.

24.4.13 Station Problem File

Type : ASCII

Directory : `$X/GEN` (UNIX) / `X:[GEN]` (VMS) / `X:\GEN` (DOS)

Content : Station problems (station name changes, set up new sites, antenna height problems).

Created by : User-defined.

Used by : ADDNEQ

Example : Figure 24.15. File available in the distribution.

Further Information : The station problem file is accessed by program ADDNEQ, only. The following changes may be specified in this file:

(1) `STATION NAME CHANGES:`
Using a time window you may change to a different station characterization (station number and the station name).

(2) `EXCLUDE STATION AND STORE TO SCRATCH STATION:`
For a given time interval you may exclude a site from a "continuous" observation series (of, e.g., daily NEQ files). The site is NOT removed from the normal equations, but the combination of the normal equation parts belonging to the specified time interval will be associated with a new name (e.g., the station name `SCRATCH`). Specifying also a different station number allows you to remove (pre-eliminate) the site (together with the option `NUMBERS OF STATIONS TO BE PREELIMINATED`).

(3) `SETUP NEW STATION:`
If you have the impression that for a certain time interval a site seems to have significantly different coordinate results than for another time period you may wish to solve for an additional set of site coordinates for this time period.

(4) `REMOVE CENTER STATIONS FROM NEQS:`
If you wish to remove center stations (see Section 24.8.2) from your normal equations (only the eccentric location of the GPS receiver is of interest) you have to specify "1" here.

(5) `ANTENNA ECCENTRICITIES:`
It is sometimes quite difficult to make sure that from the very beginning of processing correct antenna height information is used in the analysis of GPS data. If it happens, that in the processing (including GPSEST) a wrong antenna height was used, it is not necessary to recreate the normal equations. Antenna heights may be changed in ADDNEQ without having to reprocess of the GPS data using GPSEST. Only the antenna heights but not horizontal eccentricities may be changed.

(6) `NUMBERS OF STATIONS TO BE PREELIMINATED:`
To pre-eliminate a site for a certain time interval is sometimes useful. That means that this site is not included in the combined solution. Please **note** that pre-elimination is not identical to removing the site for that particular interval from the solution. The effect of the site coordinate parameters in a normal equation system on other parameters is still present (cannot be removed as if the site was not used at a particular day), but the influence of outliers on the combined solution can be reduced.

```
STATION PROBLEMS: NAMES, SITE CHANGES, HEIGHTS, ECCENTRICITIES          6-APR-94
------------------------------------------------------------------------------

STATION NAME CHANGES : (BUT STILL THE SAME SITE)
----------------------

    OLD STATION          NEW STATION
NUM       NAME       NUM       NAME                    FROM                  TO
*** **************** *** **************** YYYY MM DD HH MM SS  YYYY MM DD HH MM SS

117 JOZE             117 JOZE 12204M001   1992 01 01 00 00 00  1993 12 31 23 59 59
188 NOTO             188 NOTO 12717M003   1992 01 01 00 00 00  1999 12 31 23 59 59
  1 NOTO             188 NOTO 12717M003   1992 01 01 00 00 00  1999 12 31 23 59 59
112 MASP 31303M001   122 MASP 31303M002   1994 08 02 00 00 00  1999 12 31 23 59 59
122 MASP 31303M001B  122 MASP 31303M002   1994 08 02 00 00 00  1999 12 31 23 59 59
122 MASP 31303M001C  122 MASP 31303M002   1994 08 02 00 00 00  1999 12 31 23 59 59


EXCLUDE STATION AND STORE TO SCRATCH STATION:
---------------------------------------------

(CHANGED) STATION        SCRATCH STATION
NUM       NAME       NUM       NAME                    FROM                  TO
*** **************** *** **************** YYYY MM DD HH MM SS  YYYY MM DD HH MM SS

152 HERS 13212M007    -1 HERS SCRATCH1    1993 12 17 00 00 00  1994 01 31 23 59 59
152 HERS 13212M007    -1 HERS SCRATCH2    1994 05 25 00 00 00  1994 06 26 23 59 59
152 HERS 13212M007    -1 HERS SCRATCH3    1994 09 14 00 00 00  1994 10 03 23 59 59


SETUP NEW STATION:
------------------

CHANGED  STATION           NEW STATION
NUM       NAME       NUM       NAME                    FROM                  TO
*** **************** *** **************** YYYY MM DD HH MM SS  YYYY MM DD HH MM SS

158 ZIMM 14001M004   158 ZIMM 14001M004A  1992 01 01 00 00 00  1993 07 19 23 59 59


REMOVE CENTER STATIONS FROM NEQ'S:
----------------------------------
                                        *
(0/1 NO/YES)                       --> : 0


ANTENNA ECCENTRICITIES:
-----------------------
(CHANGED)            ANTENNA HEIGHT
STATION NAME         OLD        NEW           FROM                  TO
***************  *****.**** *****.**** YYYY MM DD HH MM SS  YYYY MM DD HH MM SS

CAGL 12725M003        0.0000     0.0450 1992 01 01 00 00 00  1999 12 31 23 59 59
SFER 13402M004        1.5536     1.6260 1992 01 01 00 00 00  1999 12 31 23 59 59


NUMBERS OF STATIONS TO BE PREELIMINATED (START A NEW ROW AFTER 15 STATIONS)
---------------------------------------------------  (-99: ALL STATIONS)

   NR  001 002 003 004 005 006 007 008 009 010 011 012 013 014 015

--> :   -1
```

Figure 24.15: Station problem file.

The effect of the first three options is in principle the same: to specify a different station name and station number. The division into these three options is useful, to keep an oversight of the reason to handle a site in this specific way. Please **note** that the renaming is done sequentially. This means, e.g, that *if you change a station name in the first option item, you have to use this new name in all following sections.*

24.4.14 Station Problem File (New Format)

Type : ASCII

Directory : `$X/GEN` (UNIX) / `X:[GEN]` (VMS) / `X:\GEN` (DOS)

Content : Station problems (station name changes, antenna height problems).

Created by : User-defined.

Used by : ADDNEQ2

Example : Figure 24.16. File available in the distribution.

Further Information : The station problem file is accessed by program ADDNEQ2, only. The following changes may be specified in this file:

(1) `RENAMING OF STATIONS:`
Using a time window you may change to a different station name.

(2) `STATION INFORMATION:`
Using a station name and a time window you may change the information about the antenna eccentricity and about the receiver and/or antenna type.

(3) `HANDLING OF STATION PROBLEMS:`
The only action taken by ADDNEQ2 is the pre-elimination of the corresponding station within the specified time interval. It means, that the flag is not currently used.

(4) `STATION COORDINATES AND VELOCITIES:`
This part of file allows you to constrain the station coordinates and/or station velocities of two stations relatively to each other. It is possible to constrain north, east and up components independently.

```
 STACRUX FILE EXAMPLE OF BERNESE GPS SOFTWARE VERSION 4.2      01-DEC-1998 13:00
------------------------------------------------------------------------------

TYPE 001: RENAMING OF STATIONS
------------------------------

STATION NAME      FLG          FROM                   TO         OLD STATION NAME  REMARK
****************  ***  YYYY MM DD HH MM SS  YYYY MM DD HH MM SS  ****************  ****************************


TYPE 002: STATION INFORMATION
-----------------------------

STATION NAME      FLG          FROM                   TO         RECEIVER TYPE         ANTENNA TYPE          REC #   ANT #    NORTH      EAST
****************  ***  YYYY MM DD HH MM SS  YYYY MM DD HH MM SS  ********************  ********************  ******  ******  ***.****  ***.****  (..)
SEY1 39801M001         1998 08 13 00 00 00  1999 04 01 23 59 59  ROGUE SNR-8000        DORNE MARGOLIN T                        0.0000    0.0000


TYPE 003: HANDLING OF STATION PROBLEMS
--------------------------------------

STATION NAME      FLG          FROM                   TO         REMARK
****************  ***  YYYY MM DD HH MM SS  YYYY MM DD HH MM SS  ****************************
REYK 10202M001         1998 11 07 00 00 00  1998 11 09 23 59 59
TROM 10302M006         1998 12 12 00 00 00  1998 12 14 23 59 59
NYAL 10317M003         1998 12 04 00 00 00  1998 12 06 23 59 59


TYPE 004: STATION COORDINATES AND VELOCITIES (ADDNEQ)
-----------------------------------------------------
                                RELATIVE CONSTR. POSITION     RELATIVE CONSTR. VELOCITY
STATION NAME 1    STATION NAME 2    NORTH     EAST      UP        NORTH     EAST      UP
****************  ****************  **.*****  **.*****  **.*****  **.*****  **.*****  **.*****
```

Figure 24.16: Station problem file (example file `STACRUX.NEW`.

24.5 Raw Data and RINEX Files

According to Table 24.1, we consider mainly the RINEX files as raw data files. We do not describe the conversion of receiver-specific observation formats to RINEX. Please read the description file of the freely available RINEX converters if you need more information related to this topics. Some information is also given in the help panels referring to the transformation programs Menu 2.5. For the definition of the RINEX format (observation files, navigation files, and meteo files) we refer to [*Gurtner*, 1994]. The GLONASS extensions of the RINEX format are described in text files available on the anonymous CODE ftp server or on the anonymous ftp server of the IGSCB (see Section 7.4).

The RINEX files are usually put into the directory `RAW` of the campaign, initially. We usually expect RINEX data with a well defined session lengths (e.g., 24 hours). The file names and extensions are in principle selectable in the transfer programs. Nevertheless we recommend to use the default extensions (file name: SSSSdddf , file extension: yyO for observation files, yyN for GPS navigation files, yyG for GLONASS navigation files, yyM for meteo files with SSSS as the 4-character station abbreviation, ddd as session identification (e.g., day of the year), f as file characterization (e.g., 1 for the first file of the session), and yy as year). If this is not the case, you might prefer to store the *original* RINEX data in the directory `ORX`. The concatenation programs for RINEX observations, RINEX navigation messages, and precise orbits (CCRINEXO (Menu 2.5.6.1), CCRINEXN (Menu 2.5.6.2), CCRINEXG (Menu 2.5.6.4), and CCPREORB (Menu 2.5.6.3)) may then be used to create RINEX files and orbit files containing a well-defined time interval of data (e.g., defined by the session table using Menu 1.3) and to store these files in the directory `RAW` and `ORB`, respectively.

24.6 Observation Files

24.6.1 General Remarks

For Version 3.0 of the *Bernese GPS Software* the decision was taken to split the observation information into two parts:

- a header file containing all the relevant information to identify and to process the observations (station, receiver, satellites, etc.).
- an observation file with all the code or phase observations.

The same structure is used in Version 4.2. This decision makes it easier to update resolved ambiguities, since only the header files have to be read and written and not all the observations.

No examples are supplied for the binary observation and header files. The ASCII image of an observation file consisting of header **and** observations contains, however, the full information of the binary version and will be described in detail below.

There are small differences between the formats of the observation files for the different versions of the *Bernese GPS Software*. *Compatibility* is guaranteed, which means that you may, e.g., process Version 3.4 observation files with Version 4.2, but not vice versa.

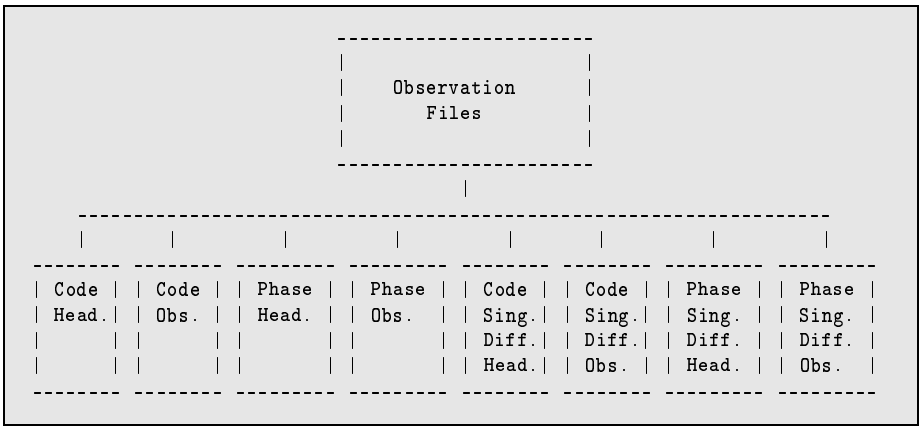

Figure 24.17: Observation files.

24.6.2 Code/Phase Zero/Single-Difference Header/Observation Files

Because of the identical format of all the header and observation files, these files are described together in one section.

Type : binary

Directory : Campaign-specific directory `OBS`.

Content : Code/phase zero/single-difference observation and associated important information in the header files.

Created by : Programs RXOBV3 (Menu 2.7.1) and SNGDIF (Menu 4.3).

Used by : All programs dealing with observation/header information (all programs in Menu 4) and some other programs (e.g., service programs in Menu 5.1).

Example : ASCII image of a header file (first part) and observation file (part 2) in Figure 24.18 for single-difference phase observations.

Further Information : All observations are stored in a binary format. The program OBSFMT (see Menu 5.7.1) and the edit and browse options of Menu 5.1 create an ASCII image of a binary file. In the binary format the header and the observations are stored in two different files. The program OBSFMT merges these two files into one ASCII image.

Remarks concerning this ASCII file:

Line :	Comment
1 :	Campaign name (ch∗16); title (ch∗53).
3 :	Measurement type: PHASE or CODE; file creation date and time.
4 :	The reference epoch is the full second part of the first observation epoch in the file; File modification date and time (updated by programs changing the file).

```
 1 IGSA            :  IGS DATA ANALYSIS
 2
 3 MEASUREMENT TYPE:  PHASE                      CREATED :  01-AUG-96 22:43
 4 REFERENCE EPOCH :  1996-07-29  0:00:30 (211)  MODIFIED:  02-AUG-96 03:29
 5
 6 # DIFFERENCES   :      1           FORMAT NUMBER      :      4
 7 # FREQUENCIES   :      2           SESSION IDENTIFIER :   2111
 8 # SATELLITES    :     24           SUBSESSION IDENTIF.:      1
 9 # EPOCHS        :   2878           OBS. INTERVAL (S)  :     30
10 # FLAGGED EPOCHS:      0           REMARK NUMBER      :      0
11
12 STATION NAME    :  KOSG 13504M003              ZIMM 14001M004
13 OPERATOR NAME   :  DANNY VAN LOON              LOGST/COMPAQ
14 RECEIVER TYPE   :  ROGUE SNR-12 RM             TRIMBLE 4000SSE
15 ANTENNA TYPE    :  DORNE MARGOLIN B            4000ST L1/L2 GEO
16 RECEIVER/ANTENNA:     229  /    119              2691  /  67905
17
18 CLOCK CORRECTION:  OFFSET PER EPOCH            OFFSET PER EPOCH
19
20 POS.ECCENTR. (M):   0.0000  0.0000  0.1050      0.0000  0.0000  0.0000
21
22 SAT    #L1-OBS OK  #L1-OBS BAD  #L2-OBS OK  #L2-OBS BAD
23  26         593          122          593          85
24   7         707          322          707         252
25   5         646          174          646         133
26  27         574          174          574         138
27 ....
28
29  AMB SAT EPOCH  WLF    L1-AMBIG.   CLUS    L2-AMBIG.   CLUS    L5-AMBIG.   CLUS
30    1  26     1  1/1       -764604.   47       -595792.   47             0.    1
31    2  26  2312  1/1             0.    2             0.    2             0.    2
32    3  26  2511  1/1      96299170.   47      75031313.   47             0.    3
33    4   7     1  1/1      -1234325.   47       -961808.   47             0.    4
34    5   7  1230  1/1             0.    5             0.    5             0.    5
35    6   7  1652  1/1      57049286.   35      44447173.   35             0.    6
36    7   7  2518  1/1             0.    7             0.    7             0.    7
37    8   7  2802  1/1      93995904.    8      73244004.    8             0.    8
38    9   7  2838  1/1      93995925.   52      73244012.   52             0.    9
39   10   5     1  1/1      -2029030.   47      -1581059.   47             0.   10
40   11   5  2837  1/1             0.   11             0.   11             0.   11
41   12  27     1  1/1             0.   12             0.   12             0.   12
42   13  27  1870  1/1      68211937.   47      52895137.   47             0.   13
43   14  27  2837  1/1             0.   14             0.   14             0.   14
44
45
46 L1,L2 OBSERVATIONS:
47 OBS.N    TIME   F #S   PHASE (M)  FFS SA       ...
48     1   0:00:30    9        -0.016S 8 26      -0.090S 7  7 ... 96-07-29 -0.000000110 -0.000129938
49                             0.060S 6 26      -0.015S 3  7 ...
50     2   0:01:00    9      2394.653  8 26   -2072.678  7  7 ... 96-07-29 -0.000000110 -0.000150902
51                           2394.728  6 26   -2072.604  3  7 ...
52
53     3   0:01:30    9     -1189.807  8  9    4787.722  8 26 ... 96-07-29 -0.000000111 -0.000171865
54                          -1189.790  5  9    4787.795  6 26 ...
55
56     4   0:02:00    7      7182.520  8 26   -6236.349  7  7 ... 96-07-29 -0.000000103 -0.000192823
57                           7182.592  6 26   -6236.273  4  7 ...
```

Figure 24.18: Example of an observation file (header in lines 1-45; observations in lines 47-57).

6 : # of differences: 0 = zero-diff. file, 1 = single-diff. file; File format number (at present always set to 4, provided for further updates).

7 : # of frequencies: 1 or 2; session number (used in program IONEST to arrange files in sessions, in program GPSEST to know which files have to be correlated).

8 : Total number of satellites in the file; The session file number is usually 1. It is 2 for the second half of a file which has been split up into two files (only important if more than one file exists for the same station and the same session).

9 : The number of epochs is not equal to the number of observation epochs. It is just the internal number of the last observation in the file.
Observation interval in seconds (sampling rates below 1 sec are not supported, at present).

10 : Number of occurrences of an epoch flag (given in the RINEX format in case of power failure). Remark number: it may be used to mark a file. The remark number is not used in any program so far, but it is printed by GPSEST.

12 : Station name(s) (ch∗16)

13 : Operator name(s) (ch∗16)

14 : Receiver type(s) (ch∗16)

15 : Antenna type(s) (ch∗16)

16 : Receiver and antenna serial number(s) (5 digits).

18 : Type of clock correction computed for the receiver clock(s): POLYNOMIAL DEG n, OFFSET PER EPOCH, or NONE.

20 : Position eccentricities in a local coordinate frame (north,east,up). The transfer programs store the vector from the marker on the ground to the antenna reference point (ARP). See file `ANTENNA.GRA` in the directory `$X/GEN` (UNIX) / `X:[GEN]` (VMS) / `X:\GEN` (DOS) for the definition of the ARP for various antenna types. Usually the eccentricities in north and east direction are zero and the third eccentricity (up) is equal to the antenna height.

22 : List (lines 23–26) of the satellite numbers, and the number of good and marked observations for each satellite (L_1 or L_1&L_2).

29 : List (lines 30–43) of ambiguities containing the ambiguity number, the satellite number, the start epoch of the ambiguity, the wavelength factor(s) for one or both frequencies, the value of the ambiguities within the corresponding cluster, and the ambiguity cluster number. If two frequencies are available the widelane ambiguity (L_5) is stored (together with its cluster number), too, independently of the L_1 and L_2 ambiguities. If two ambiguities of the same frequency belong to the same ambiguity cluster (i.e., they have the same cluster number), they are *resolved* relative to each other (as double-difference ambiguity).

46 : List of all the observations, where you find the following values:

- Internal observation number (used as reference)
- Observation time (full seconds only)
- Epoch flag (provided by the RINEX format, e.g., for power failure)
- Number of satellites observed at this epoch
- For each satellite observed (`#S`):
  - observation (in meters)
  - two flags possible (FF):
    S: cycle slip
    M: marked observation

  - signal/noise ratio (S)
  - SV-number (SA)
- Date of observation
- Clock parameter for station 1 (sec):
  - Zero-difference files: fractional second of observation epoch
  - Single-diff. files: sum of fractional second of observation epoch + clock correction to GPS time for station 1
- Clock parameter for station 2 (sec):
  - Zero-difference files: clock correction to GPS time for current epoch
  - Single-diff. files: sum of fractional second of observation epoch + clock correction to GPS time for station 2

The L_2-observations follows in the next line (if available).

52 : A blank line is inserted into the formatted file whenever one or more observation epochs are missing or if the satellite constellation changes. Blank lines between the observations will be removed when the file will be transformed back into a binary file.

24.7 Orbit Files

The orbit files types, explained in this section, are shown in Figure 24.19.

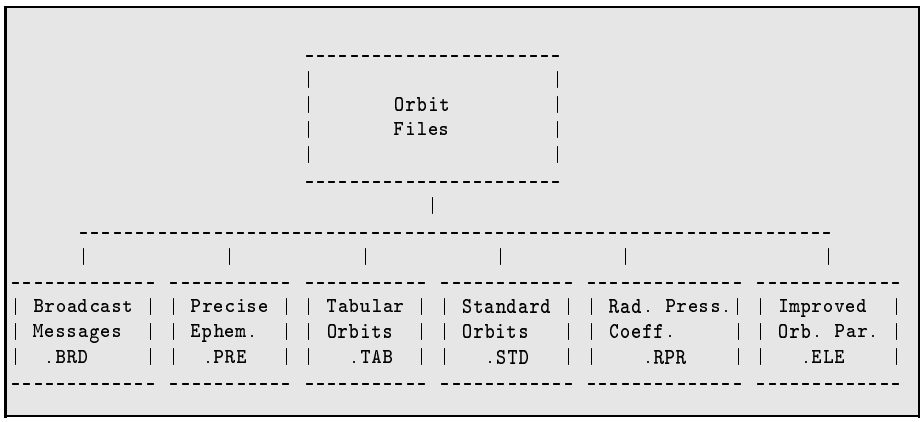

Figure 24.19: Orbit files.

24.7.1 Satellite Broadcast Messages

Type : ASCII

Directory : Campaign-specific directory `ORB`.

Content : Satellite broadcast messages.

Created by : Transformation programs (e.g., RXNBV3 (Menu 2.7.2)).

Used by : BRDCHK, BRDTST, BRDTAB, CODSPP, SATCLK, GPSSIM, and BV3RXN.

Example : Figure 24.20.

Further Information : The file is truncated in the middle of the first message. The first record is a title line. Each message (containing 2·20 parameters: 20 for ephemerides and 20 for satellite clocks) is preceeded by a record in which the satellite number and a sequence number for the messages of a satellite is contained. This sequence number is never used by the accessing programs, which means that different broadcast files may be merged into one file (by removing the title line of the file to follow). The values in the broadcast messages are explained in the header of the subroutine `GTBRDC`. A description of the message may also be found in [*Dierendonck et al.*, 1978].

```
BROADCAST NAVIGATIONS OF DOY 211 (1996)                    01-AUG-96 22:08
SVN-NUMBER=  2  MESSAGE-NR=  1
    0.86400000000000000D+03
    0.86400000000000000D+05
    0.26560490031020127 2D+08
    0.15822053188499999 4D-01
    0.94575083916400004 6D+00
   -0.36996676109199999 6D+00
   -0.24377423540100000 6D+01
   -0.21998026534199999 2D+01
    0.43669676160200002 3D-08
    ....
```

Figure 24.20: Broadcast messages (`.BRD` File). 40 lines of information per message.

24.7.2 Precise Ephemerides in IGS Format

Type : ASCII

Directory : Campaign-specific directory `ORB`.

Content : Precise ephemerides.

Created by : STDPRE (Menu 3.7). Official exchange format within IGS.

Used by : PRETAB.

Example : Figure 24.21 shows a precise orbit file created by CODE for July 26, 1996.

Further Information : The example file is truncated. It is given in the SP3 format. Apart from SP3 two older precise orbit file formats (SP1 and SP2) may be read and written by the *Bernese GPS Software*. All the satellite positions in the precise files are given in an Earth-fixed reference frame.

SP1 : positions of the satellites

SP2 : positions and velocities of the satellites

SP3 : positions in km (and optionally velocities) and clock information of the satellites in microsec.

The recommended format is SP3. For detailed informations see [*Remondi*, 1989].
The satellite-specific formal rms values (lines 8–9, specifying the rms in 2^x cm, $x = 5 - 14$, accuracy codes) are used in the option Panel 4.5–2.4.5 of the program GPSEST. An automated procedure to include this information into the processing is not yet implemented (but will be implemented in the next Version). For more details on the satellite clock values (last column, 999999.999999 if not available) and their use see Chapter 16.

```
#aP1996  7 26  0  0  0.00000000      96 d+D   ITR94     AIUB
##  863 432000.00000000   900.00000000 50290 0.0000000000000
+   24     1  2  3  4  5  6  7  9 14 15 16 17 18 19 21 22 23
+         24 25 26 27 28 29 31  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  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
++         5  5  5  5  5  5  6  5 13  5 14  5 10  7  7  5 10
++         5  5  5  5  5  5  5  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  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
%c cc cc ccc ccc cccc cccc cccc cccc cccc ccccc ccccc ccccc ccccc
%c cc cc ccc ccc cccc cccc cccc cccc cccc ccccc ccccc ccccc ccccc
%f  0.0000000  0.000000000  0.00000000000  0.000000000000000
%f  0.0000000  0.000000000  0.00000000000  0.000000000000000
%i    0    0    0    0      0      0      0      0         0
%i    0    0    0    0      0      0      0      0         0
/*
/* CENTER FOR ORBIT DETERMINATION IN EUROPE (CODE)
/* ORBIT FOR DAY 208, 1996
/* INCLUDING PRECISE CODE CLOCKS
*  1996  7 26  0  0  0.00000000
P  1 -14491.161032 -21128.605174   7084.280168    151.177872
P  2   6536.289780  14333.529397  21736.647326   -276.168883
P  3 -22063.973998 -10882.831340   9736.787369     35.186262
P  4   7644.813614  18503.431109 -17297.334415     36.640813
P  5  23219.281286 -11703.679564  -5382.413597     49.562138
P  6   3915.372266 -16216.668310 -20522.976533      1.941337
P  7  14443.229628  20962.100466   8270.040181    724.363306
P  9  15218.229380 -14514.071947  16079.414784     -4.722523
. ..      ...           ...           ...           ...
```

Figure 24.21: Precise orbit file in SP3 format (`.PRE` file).

24.7.3 Tabular Orbits

Type : ASCII
Directory : Campaign-specific directory `ORB`.

Content : Tabular satellite positions in the inertial frame B1950.0 or J2000.0.

Created by : PRETAB, BRDTAB (Menu 3.2).

Used by : ORBGEN (Menu 3.3).

Example : Figure 24.22.

Further Information : The orbit source is specified in the title line from col. 44 to 53. This information is transferred to the standard orbit file by program ORBGEN. The next two non-blank lines contain start/end time. They are followed by the tabular interval and the (nominal) number of ephemeris points. The next line contains pole information (which is not used by the program system). In the following lines the number of satellites and the satellite numbers (svn-numbers) are defined. Finally the satellite positions (in system B1950.0 or J2000.0) are given in km. Satellite and epoch belonging to a specific record are reconstructed from the record number which is the first item of each record. Records of satellites for which no positions exist for a certain time interval are missing in the file to save space.

```
TABULAR EPHEMERIS DERIVED FROM BROADCAST:  BR1996.211  SYSTEM J2000.0

   7   29 1996  0.000000000000D+00  0.000000000000D+00  0.000000000000D+00
   7   29 1996  0.220000000000D+02  0.450000000000D+02  0.000000000000D+00
 0.900000000000D+03   92
      0.153823072876D+00       0.257323273765D+00       0.463439049019D+00



   25
SVN       2

...       ..

SVN      28

    1    0.148088880106306D+05    0.526968628751150D+04    0.217210548547628D+05
    2   -0.228073271915016D+05    0.110636130396568D+05    0.758882498409432D+04
    3    0.203270096134166D+05    0.630055979043172D+04   -0.157236271029107D+05
    4    0.497064287709960D+04   -0.259077498072103D+05   -0.306132213646616D+04
```

Figure 24.22: Tabular orbit information (`.TAB` file).

24.7.4 Standard Orbits

Type : Binary

Directory : Campaign-specific directory `ORB`.

Content : Standard orbit (Bernese orbit representation using sets of polynomials).

Created by : ORBGEN (Menu 3.3).

Used by : Some orbit programs (e.g., STDDIF (Menu 3.6)) and the processing programs (Menu 4).

Example : Figure 24.23 (ASCII example).

Further Information : A standard orbit contains all the information to compute position, velocity, and higher time derivatives for each satellite. The orbit is stored in the form of polynomial coefficients (one set of coefficients for typically 1 hour). One standard orbit file may contain several arcs per satellite. For additional information we refer to Chapter 8. The format is binary. To transform it to ASCII and back to binary (e.g., to allow a transfer to a different computer platform) please use the programs STDFMT and FMTSTD (Menu 5.7.3 and Menu 5.7.4) (default extension for the ASCII files: `FSO`).

```
   1
     24     24     10
  1  2  3  4  5  6  7  9 14 15 16 17 18 19 21 22 23 24 25 26 27 28 29 31
PR1996.211
   50293.00000000000       2.000000000000000
   50293.00000000000
   50293.04166666666
   50293.08333333334
   ...
   50293.95833333334
   50294.00000000000
   26560826.97948544
  3.5948010304332765E-03
  0.9542003285019213
   2.934056532237261
  -1.468848451338153
  0.4411324010901875
  -13048.98532573050
   ...
```

Figure 24.23: Standard orbits (`.STD / .FSO` file).

24.7.5 Radiation Pressure Coefficient File

Type : binary

Directory : Campaign-specific directory `ORB`.

Content : Radiation pressure coefficients and partial derivatives of the satellite positions with respect to the radiation pressure coefficients. Starting with Version 4.0 the partial derivatives of the satellite positions with respect to the Keplerian elements at the beginning of the arc are contained in this file, too.

Created by : ORBGEN (Menu 3.3).

Used by : Some orbit programs (e.g., ORBGEN (Menu 3.6) in the UPDATE mode, and the processing program GPSEST (Menu 4.5) for orbit improvements.

Example : not given. The structure of this file is similar to the standard orbit file (e.g., more than one arc per satellite possible).

Further Information : Only if you want to improve orbits it is necessary to generate an RPR file with the program ORBGEN. In all other cases the STD files are sufficient for the orbit representation. For additional information see Chapter 8. The format is binary. To transform it to ASCII and back to binary (e.g., to allow a transfer to a different computer platform) please use the programs STDFMT and FMTSTD (Menu 5.7.3 and Menu 5.7.4) (default extension for the ASCII files: FRP).

24.7.6 Improved Orbit Parameters

Type : ASCII

Directory : Campaign-specific directory ORB.

Content : a priori and estimated orbit parameters.

Created by : GPSEST (Menu 4.5), ADDNEQ (Menu 4.8.1), and ADDNEQ2 (Menu 4.8.3).

Used by : ORBGEN (Menu 3.3) in the UPDATE mode and in STDPRE (Menu 3.7) to derive approximated rms values of the orbit quality for each satellite.

Example : Figure 24.24: The example file shows that in this case each arc is characterized by 18 orbital elements (6 Keplerian elements, 9 radiation pressure coefficient parameters, and 3 pseudo-stochastic parameters (for the middle of the arc).

Further Information : Information concerning the orbital parameterization is given in Chapter 8. Some additional remarks:
The first column contains the a priori orbital parameters, column 2 and 3 the improved values and their rms. The "*" indicates that a parameter was not estimated, ORBSYS 2 in the last column defines the orbital system (ORBSYS 1 : B1950.0, ORBSYS 2 : J2000.0), and the string T950101A characterizes, if present, the a priori model for radiation pressure and other important details of the orbit model used (e.g., the a priori geopotential model). Pseudo-stochastic orbit parameters are listed at the end of the file.

```
IGSG: PHASE, DAY 211 2.ITER., UT-DRIFT                          02-AUG-96 01:26
ARC-NUMBER          =  1 SATELLITE           =  1 TOSC=  50293.00000000
-------------------------------------------------------------------------
A                   =  26560826.98946  26560826.91732 +-       0.015    ORBSYS 2
E                   =    0.0035947990    0.0035948031 +- 0.000000001    ORBSYS 2
I                   =    54.671651606    54.671651619 +- 0.000000031    ORBSYS 2
NODE                =   168.109056017   168.109056133 +- 0.000000040    ORBSYS 2
PERIGEE             =   -84.158791831   -84.158795875 +- 0.000005403    ORBSYS 2
ARG. OF LAT (START) =    25.275024577    25.275024809 +- 0.000000071    ORBSYS 2
D0                  = 0.155046176D-08 0.126760141D-08 +- 0.46039D-10    T950101A
Y0                  = 0.471002168D-09 0.257668622D-09 +- 0.40494D-10    T950101A
X0                  = 0.116292411D-13 0.887684490D-14 +- 0.91232D-12    T950101A
DC                  =-0.185798098D-13-0.153224647D-13 +- 0.91232D-12    T950101A
YC                  = 0.244501744D-12 0.253540023D-12 +- 0.91231D-12    T950101A
XC                  =-0.188645824D-13-0.252024003D-13 +- 0.91233D-12    T950101A
DS                  =-0.328753303D-14 0.555007628D-14 +- 0.91231D-12    T950101A
YS                  =-0.302597989D-13-0.359210317D-13 +- 0.91233D-12    T950101A
XS                  = 0.000000000D+00 0.000000000D+00 +- 0.000000+00  * T950101A
ARC-NUMBER          =  1 SATELLITE           =  2 TOSC=  50293.00000000
...
*** STOCHASTIC ORBIT PARAMETERS ***
-------------------------------------------------------------------------------
ARC-NUMBER          =  1 SATELLITE           =  1 TOSC=  50293.00000000
-------------------------------------------------------------------------
 1 3  13 50293.50000  0.000000000D+00 0.631696580D-07    0.90311D-06
 2 3  13 50293.50000  0.000000000D+00-0.568229193D-05    0.10383D-05
 3 3  13 50293.50000  0.000000000D+00-0.558700349D-14    0.91233D-09
...
```

Figure 24.24: File of a priori and estimated orbit parameters (`.ELE` file).

24.8 Miscellaneous Files

The *Bernese GPS Software* makes use of a big variety of miscellaneous files. Most of them are pure INPUT files, some are INPUT and/or OUTPUT files. The default path for most of them is the campaign-specific directories `OUT` or `STA`.

24.8.1 Station Coordinates

Type : ASCII

Directory : Campaign-specific directory `STA`.

Content : Geocentric station coordinates.

Created by : User-defined (Menu 1.4.1) or as output result of the processing programs RXOBV3, CODSPP, MAUPRP, GPSEST, ADDNEQ or ADDNEQ2 (Menu 4), or of the service programs HELMR1 and COMPAR.

Used by : Processing programs (with the exception of ADDNEQ and ADDNEQ2) as a priori coordinates.

```
ITRF97 EPOCH 1997.0 GENERATED FROM ITRF97_GPS.SNX                  27-JUL-1999
--------------------------------------------------------------------------------
LOCAL GEODETIC DATUM: ITRF97           EPOCH: 1997-01-01  0:00:00

NUM  STATION NAME           X (M)          Y (M)          Z (M)     FLAG

101  GRAS 10002M006     4581691.0258    556114.6863   4389360.6849    F
102  TOUL 10003M004     4627846.1397    119629.1837   4372999.7115    W
103  REYK 10202M001     2587384.5001  -1043033.5002   5716563.9689    I97
104  HOFN 10204M002     2679690.0210   -727951.3306   5722789.1416    W
105  TRO1 10302M006     2102928.6248    721619.3908   5958196.1860    I97
106  OSLO 10307M001     3169981.9958    579956.6949   5485936.5846    I97
107  NYAL 10317M001     1202430.6499    252626.6518   6237767.5126    W
108  VARD 10322M002     1844607.4646   1109719.1265   5983936.0940    W
109  STAV 10330M001     3275753.7325    321110.9456   5445041.9715    I97
110  TRON 10331M001     2820170.9828    513485.9507   5678935.8954    W
111  ONSA 10402M004     3370658.6756    711877.0294   5349786.8684    W
112  KIRU 10403M002     2251420.9328    862817.1406   5885476.6048    W
...  ....                     ...            ...           ...       ...
```

Figure 24.25: Coordinate (`.CRD`) file.

Example : Figure 24.25. ITRF coordinate files (ITRF93, ITRF94, ITRF96, ITRF97, etc.) for most of the permanent global IGS sites are available in the anonymous CODE ftp area (see Section 7.4).

Further Information :

- Each coordinate file has to contain in line 3 the name of a geodetic datum specified in the datum file (see Section 24.4.2). Geodetic datum does **not** mean that the coordinates below are referring to this datum (unless the coordinates are given as latitude, longitude, and height, see remark below). The geodetic datum is only used to compute ellipsoidal coordinates in the processing programs if necessary. Whenever possible the geocentric coordinates should refer to the ITRF (i.e., to the same reference frame as the precise orbits used). You have the following two possibilities:
  - Give rectangular coordinates in the geocentric system referring to the same reference frame as the used orbits and the a priori coordinates, independent of the specified geodetic datum in line three.
    Format: (I3,2X,A16,3F15.4,4X,A1)
  - Give latitude, longitude, and height in the geodetic datum specified in line three.
    Format: (I3,2X,A16,2X,A1,I2,I3,F9.5,2X,A1,2I3,F9.5,F11.4, 3X,A1)
- The coordinate epoch is written by the programs ADDNEQ and ADDNEQ2 only. It is used in the programs HELMR1 (see Chapter 11) and the non-menu-program COOVEL (propagation of coordinates to a different epoch with help of a velocity file).
- Two title lines are followed by the line where the geodetic datum is specified. The end of the input file is indicated by a blank line.

Lines below the blank line are ignored. The station number is read and used in the program system (mainly for selecting stations in the F-files).

- Different programs mark the estimated coordinates with different flags.

  R : coordinates extracted from RXOBV3
  C : coordinates estimated by CODSPP
  T : coordinates estimated by MAUPRP (triple-diff. solution)
  P : coordinates estimated by GPSEST
  F : coordinates were kept fixed in the estimation procedure (GPSEST and ADDNEQ).
  M : coordinates which were estimated by ADDNEQ.
  W : coordinates which were weighted (ADDNEQ and ADDNEQ2).
  A : coordinates which were estimated (but not weighted) by ADDNEQ2.
  N : coordinates which were used for no-net translation and rotation conditions (ADDNEQ).
  others : sites which are marked manually (Menu 1.4.1) with a special flag in the a priori coordinate file (e.g., I97 in the Figure 24.25 means coordinates stemming from the ITRF97 solution).

24.8.2 Station Eccentricity Elements

Type : ASCII

Directory : Campaign-specific directory `STA`.

Content : Station eccentricities.

Created by : User-defined, assistance using Menu 1.4.4.

Used by : All processing programs.

Example : Figure 24.26.

Further Information : With an eccentricity file it is possible to have receivers at eccenter points with a known position relative to the center station. Introducing the eccentricity elements as given, only the coordinates of the center station will be estimated in GPSEST. In some cases it is easier to estimate the eccenter coordinates (where the GPS receiver/antenna is located) and to handle the eccentricity problem outside of the Bernese programs (especially if the eccenter values are not precisely known). In that case no eccenter file is needed.

The eccenter file may also be used to estimate one set of coordinates for two receivers by introducing the known vector between the two sites into an eccentricity file.

This file contains:

- eccenter station number
- eccenter station name
- name of center station belonging to the eccenter station

- eccentricities (DN, DE, DH) in the local geodetic datum specified in the third line of the file if you set SYSTEM to "L" (L:LOCAL) or the (DX, DY, DZ) eccentricities in the geocentric system (G:GEOCENTRIC). The datum must be equal to the datum in the coordinate file used. The eccentricities are added to the coordinates of the center station to obtain the eccenter station coordinates.

The end of the list is indicated by a blank line.

The following strategy is used to obtain the coordinates of a given list of station names:

(1) If there is no eccentricity file name specified in the menu programs all the stations in the list are assumed to be center stations and the coordinates are directly taken from the coordinate file used.

(2) If an eccentricity file is specified, this file is screened for station names in the list, first.
   - If a station name is found in the eccentricity file the station is assumed to be an eccenter and the eccentricities (DN, DE, DH) or (DX, DY, DZ) are added to the coordinates of the corresponding center stations which in turn, must be included in the coordinate file.
   - If a station name is not found in the eccentricity file the station is assumed to be a center station and the coordinates will be taken from the coordinate file.

```
CODE: ITRF SITE ECCENTRICITY FILE (IGSMAIL 263)                 24-SEP-93 21:04
-------------------------------------------------------------------------------
LOCAL GEODETIC DATUM: WGS - 84           SYSTEM : G (G: GEOCENTRIC, L: LOCAL)
                                                  CENTER --> STATION
NUM  STATION NAME      CENTER NAME          DX (M)     DY (M)     DZ (M)

151  GRAZ 11001M002    GRAZ 11001S002      -2.5590     8.5160    -1.3210
152  HERS 13212M007    HERS 13212S001       6.5050    10.2780    -3.9450
153  KOSG 13504M003    KOSG 13504M002     -12.4610   -37.5030    23.0240
154  MADR 13407S012    MADR 13407S010    -134.2460   159.6640   164.2750
155  MATE 12734M008    MATE 12734S001     -15.1730   -24.8270    24.9650
156  TROM 10302M003    TROM 10302M002      36.2880   -33.1150    -9.2150
157  WETT 14201S020    WETT 14201S004      38.6970   117.4170   -59.3220
158  ZIMM 14001M004    ZIMM 14001S001      13.6800     6.0120    -6.2420
...  ....              ....                 ...        ...        ...
```

Figure 24.26: Station eccentricity (.ECC) file.

24.8.3 Station Velocities

Type : ASCII

Directory : Campaign-specific directory `STA`.

Content : Station velocity information.

Created by : User-defined, created by ADDNEQ (Menu 4.8.1) or ADDNEQ2, or created by the non-menu program NUVELO. The format is identical with the coordinate file. Therefore you may use Menu 1.4.1 as assistance for editing the file.

Used by : ADDNEQ, ADDNEQ2: as a priori velocity information or as output file for the velocity estimates.

Example : Figure 24.27. ITRF velocity files (ITRF93, ITRF94, ITRF96, ITRF97, etc.) for most of the global permanent sites are available in the anonymous CODE ftp area (see Section 7.4).

Further Information :

- Station names have to be identical to the station names of the coordinate files (or center name of the eccentricity file).
- The information concerning the local geodetic datum has to be identical to the one in the coordinate file used.
- Velocity information (VX, VY, VZ in meter per year) has to be given in the geocentric coordinate system.
- Velocity flags are almost identical to the coordinate flags:

  F : velocities which were fixed to a certain value (ADDNEQ).
  W : velocities for which a priori weights were used (ADDNEQ and ADDNEQ2). Because the velocity estimation is activated using weights, the velocities will get this flag type, even if large a priori sigmas are specified (e.g., 1000 mm/yr).
  N : stations which were used for no-net translation and rotation conditions (ADDNEQ).
  A : velocities which were estimated (but not weighted) by ADDNEQ2.

```
ITRF97 EPOCH 1997.0 GENERATED FROM ITRF97_GPS.SNX                  27-JUL-1999
--------------------------------------------------------------------------------
LOCAL GEODETIC DATUM: ITRF97

NUM  STATION NAME          VX (M/Y)       VY (M/Y)       VZ (M/Y)  FLAG   PLATE

101  GRAS 10002M006          -0.0118         0.0185         0.0090    F    EURA
102  TOUL 10003M004          -0.0094         0.0178         0.0086    F    EURA
103  REYK 10202M001          -0.0201        -0.0035         0.0083    F    NOAM
104  HOFN 10204M002          -0.0103         0.0130         0.0058    I97  EURA
105  TROM 10302M003          -0.0175         0.0076         0.0050    F    EURA
106  OSLO 10307M001          -0.0131        -0.0035         0.0016    I97  EURA
107  NYAL 10317M001          -0.0155         0.0070         0.0032    F    EURA
108  VARD 10322M002          -0.0139         0.0202         0.0228    I97  EURA
109  STAV 10330M001          -0.0064         0.0065         0.0159    F    EURA
110  TRON 10331M001          -0.0212         0.0255         0.0019    I97  EURA
```

Figure 24.27: Site velocity (`.VEL`) file.

others : sites which were marked manually (Menu 1.4.1) with a special flag in the a priori coordinate file (e.g., G in Figure 24.27 means GPS-derived ITRF velocities).

- The tectonic plate information is important for the non-menu program NUVELO to derive a new NNR-NUVEL1 or NNR-NUVEL1A velocity file. Specifying this file in Menu 4.8.1 (option PLATE TABLE NUVEL1) of the program ADDNEQ means to apply the NNR-NUVEL1 model instead of using the numerical values given in the velocity file (velocity values are not necessary in this case).

24.8.4 Station Name Translation Table

Type : ASCII

Directory : Campaign-specific directory STA.

Content : Station name translation table for the transfer programs.

Created by : User-defined, assistance using Menu 1.4.2 .

Used by : RXOBV3 and RXMBV3 (Menu 2.7.1 and Menu 2.7.3).

Example : Figure 24.28. The file is also available in the distribution.

Further Information : The translation table may be used in the transformation programs creating Bernese observation files to obtain standardized station names for an entire campaign. If this file is specified in the menu programs all station names found in the raw data (RINEX) will be translated according to the translation table.
Wildcards are allowed!

```
CODE: SITE NAME TRANSLATION TABLE                                    6-APR-93 12:12
------------------------------------------------------------------------------------

NUM  OLD STATION NAME  NEW STATION NAME

111  *NALL*            NYAL 10317M001
111  *NY*              NYAL 10317M001
122  *MAS1*            MASP 31303M001B
123  *BOR1*            BOR1 12205M002
153  *KOSG*            KOSG 13504M003
153  *KOOT*            KOSG 13504M003
154  *DSS60*           MADR 13407S012
154  *DSCC60*          MADR 13407S012
154  *MADR*            MADR 13407S012
156  *TROM*            TROM 10302M003
157  *WETTZELL-1200*   WETT 14201M009
157  *WETTZELL PILLAR* WETT 14201M009
```

Figure 24.28: Station name translation (.STN) file.

24.8.5 Variance-Covariance Matrix

Type : ASCII

Directory : Campaign-specific directory `OUT`.

Content : Variance-covariance matrix of the least square adjustment.

Created by : GPSEST (Menu 4.5), ADDNEQ (Menu 4.8)/ ADDNEQ2, and COMPAR (Menu 5.4.1).

Used by : COMPAR (Menu 5.4.1) for combination of solutions.

Example : Figure 24.29 for type 1.

Further Information : There are two different file types that may be created.

(1) Variance-covariance matrix of the station coordinates and velocities only (may be used as input together with the coordinate files in the program COMPAR).
(2) The full variance-covariance matrix including a parameter characterization list at the beginning of the file. We do not recommend to specify this type of output, because this file cannot be used in other Bernese programs and a big file may be created. An example file is given in the distribution.

This file (type 1) may, e.g., be used to combine GPS solutions with terrestrial geodetic network solutions using different adjustment software tools. The combination of different (GPS) solutions may be performed using the program COMPAR (coordinates only, no datum transformations possible) or using the program ADDNEQ or ADDNEQ2 (all parameter types supported, based on normal equations (`NEQ`/`NQ0` format according to Section 24.8.8,ff.)). Furthermore, it is possible to extract from these files the necessary information for plotting error ellipses (see Figure 18.6).

```
COMBINATION GPSWEEK 0862, EUROPE                                  06-AUG-96 16:34
------------------------------------------------------------------------------

UPPER TRIANGULAR PART OF VARIANCE-COVARIANCE MATRIX FOR COORDINATES/VELOCITIES:
------------------------------------------------------------------------------

RMS OF UNIT WEIGHT:  0.0023  # OBS:     670404  # UNKNOWNS:     9309


STATION 1        XYZ    STATION 2        XYZ FLG    MATRIX ELEMENT

BOR1 12205M002    X     BOR1 12205M002    X         0.9024207094D-01

BOR1 12205M002    Y     BOR1 12205M002    X         0.2689456956D-01
BOR1 12205M002    Y     BOR1 12205M002    Y         0.1096727406D-01

BOR1 12205M002    Z     BOR1 12205M002    X         0.1169366832D+00
BOR1 12205M002    Z     BOR1 12205M002    Y         0.3615627381D-01
BOR1 12205M002    Z     BOR1 12205M002    Z         0.1628096272D+00

KOSG 13504M003    X     BOR1 12205M002    X         0.2910501004D-02
KOSG 13504M003    X     BOR1 12205M002    Y         0.3126282733D-03
KOSG 13504M003    X     BOR1 12205M002    Z         0.3401657909D-02
KOSG 13504M003    X     KOSG 13504M003    X         0.1630786764D-01
....
```

Figure 24.29: Variance-covariance (`.COV`) file of type 1.

24.8.6 Residual Files

Type : binary

Directory : Campaign-specific directory `OUT`.

Content : Residuals stemming from the processing programs.

Created by : CODSPP (Menu 4.2), MAUPRP(Menu 4.4.2), GPSEST (Menu 4.5), IONEST (Menu 4.7), and ORBGEN (Menu 3.3).

Used by : REDISP (Menu 5.3.1) to browse residuals of different programs in a window of 80 character widths, RESRMS (Menu 5.3.2) to check residuals for outliers. The Graphic Tool GT (see Chapter 21; Menu 5.3.3) allows a graphical presentation of the residuals, to create an edit file (see Section 24.8.15) containing the data to be marked and also informations to set up additional ambiguities.

Example : -

Further Information : ASCII versions of a residual file may be created using Menu 5.3.1 if you specify a list file (see Section 24.8.10).

24.8.7 Program Output Files

Type : ASCII

Directory : Campaign-specific directory `OUT`.

Content : Job output of the main GPS programs GPSEST and ADDNEQ.

Created by : GPSEST (Menu 4.5) and ADDNEQ (Menu 4.8.1).

Used by : GPSXTR (Menu 5.6.5) to extract information from the output files. Suited for a summary file extraction in an automated processing using the BPE.

Example : -

Further Information : If no file name is specified (in Panel 4.5–1 (GPSEST) or in Panel 4.8.1–1 (ADDNEQ), respectively, option `GENERAL OUTPUT`) the job output is routed to the default output file name `PGMNAM.Lnn` (`nn` = 01 - 99) or `PGMNAM.nnn` (`nnn` = 001 - 999) (see Section 3.6.2). If a file name is specified, the output is routed to that file with the default extension `OUT`.

Using the menu system (`JOB` or Menu 5.9) it is also possible to create a list file (`.LST`; see also Section 24.8.10) from a program output file `PGMNAM.Lnn` or `PGMNAM.nnn`, respectively.

24.8.8 Normal Equation Files

Type : binary (default) or ASCII (*both* formats are handled by ADDNEQ, but only binary is economical).

Directory : Campaign-specific directory `OUT`.

Content : Normal equations and important a priori information.

Created by : GPSEST (Menu 4.5) and ADDNEQ (Menu 4.8.1).

Used by : ADDNEQ (Menu 4.8.1) to combine sequential solutions.

Example : -

Further Information : Normal equation files contain important information concerning the a priori values used as well as the normal equations computed in the main parameter estimation program GPSEST. It is possible to store all GPS parameter types in the normal equations (even if that is not recommended). For more information on normal equations we refer to Chapters 18 and 19).

To transform binary normal equations (NEQs) into ASCII files (necessary if you have to change the computer platform), you may use the program NEQFMT (no menu system support) which is also suited to transform ASCII NEQs into binary NEQs.

24.8.9 Normal Equation Files (New Format)

Type : binary

Directory : Campaign-specific directory `OUT`.

Content : Normal equations and important a priori information.

Created by : GPSEST (Menu 4.5), ADDNEQ2 (Menu 4.8.3), and SNX2NQ0 (no menu support).

Used by : ADDNEQ2 (Menu 4.8.3) to combine sequential solutions.

Example : -

Further Information : Normal equation files contain important information concerning the a priori values used as well as the normal equations computed by the main parameter estimation program GPSEST. For more information on normal equations we refer to Chapter 19).

To transform binary normal equations files into ASCII files and vice verse (necessary if you have to change the computer platform), you can use the program NEQ2ASC in Menu 5.7.5.

24.8.10 List Files

Type : ASCII

Directory : Campaign-specific directory `OUT`.

Content : Contains special output information (sometimes a pure copy of output information which is usually removed automatically).

Created by : CRRCANT (Menu 1.4.5): Output of the translation table,
DEFXTR (Menu 5.6.2): Output of extraction results,
HELMER (Menu 5.4.2): Output file
JOB (Menu 5.9): Create a list file from a program output (see Section 24.8.7),
ORBIMP (Menu 3.9.3): Summary file of the job output used as input for program, PREWEI (see below),
PREWEI (Menu 5.6.7): Input file (containing quality information for each satellite),
REDISP (Menu 5.3.1): Save binary residual file to ASCII list file.

Used by : Operator to save, e.g., important job output information.

Example : -

Further Information : -

24.8.11 Plot File

Type : ASCII

Directory : Campaign-specific directory `OUT`.

Content : Plot information.

Created by : ADDNEQ (Menu 4.8.1) and COMPAR (Menu 5.4.1): to store coordinate residuals (N, E, U).
POLXTR (Menu 5.3.1): to store Earth rotation parameter estimates.
STDDIF (Menu 3.6): to store differences between orbits (radial, along, and out of plane).

Used by : The operator to produce plots of residuals (using an arbitrary plot program).

Example : -

Further Information : The plot files only contain the data to be plotted. You may import this information into any plot program.

24.8.12 Pole File in IERS Format

Type : ASCII

Directory : Campaign-specific directory `OUT`.

Content : Pole coordinates and UT1-UTC together with some statistical information on these estimated parameters.

Created by : Parameter estimation program GPSEST (Menu 4.5) or ADDNEQ/ADDNEQ2 (Menu 4.8.x) or by other IGS analysis centers.

Used by : Extraction programs POLUPD (Menu 5.5.1), POLXTR (Menu 5.5.2), submission format of Earth rotation parameters for IERS.

Example : Figure 24.30: Here we present subdaily Earth rotation estimates (2 hour time intervals) in the `IEP` format stemming from a 3-days arc. The rightmost columns listing the correlations and nutation estimates are not reproduced. Example also available in the distribution.

Further Information : This file is only used to send pole, UT1-UTC, and nutation information from global Earth rotation parameter estimations to the IERS Bureau. It is probably not of importance for the general user. Note that starting on GPS week 0966 a new version of the format (version 2) was implemented for all official IGS products in order to get an increased resolution for the polar motion coordinates, their rates, UT/LOD, and their respective sigmas (see `IGSMAIL #1943`).

```
VERSION 2
IGSFIN3D: X3 3-DAY SOLUTION DAY: 01010                          15-JAN-01 03:25
----------------------------------------
CELESTIAL POLE OFFSET: OBSERVED                SUBDAILY POLE MODEL: RAY
  MJD         X-P      Y-P   UT1UTC    LOD   S-X   S-Y  S-UT  S-LD  NR  NF  NT
              E-6"     E-6"    E-7S E-7S/D   E-6"  E-6" E-7S E-7S/D
51918.00   -70239   410546   872610   3434    13    12     1     8 132  44  28
51918.04   -70217   410621   872467   3434    13    12     1     8 132  44  28
51918.08   -70196   410696   872324   3434    13    12     1     8 132  44  28
51918.08   -70196   410696   872324   3428    13    12     1     8 132  44  28
51918.12   -70174   410771   872181   3428    13    12     2     8 132  44  28
........
51920.88   -68741   415717   859758   6490    13    12    22     8 132  44  28
51920.92   -68719   415792   859486   6490    13    13    22     8 132  44  28
51920.92   -68719   415792   859486   6638    13    13    22     8 132  44  28
51920.96   -68697   415867   859211   6638    13    13    23     8 132  44  28
51921.00   -68676   415942   858932   6638    13    13    23     8 132  44  28
```

Figure 24.30: Example file (`.IEP`).

24.8.13 SINEX File

Type : ASCII

Directory : Campaign-specific directory `OUT`.

Content : Coordinates and velocities in the Software INdependent EXchange format (SINEX) Version 1.00.

Created by : ADDNEQ (Menu 4.8.1) and ADDNEQ2 (Menu 4.8.3).

Used by : IGS Global Network Associated Analysis Centers (GNAACs) to combine global solutions with regional GPS solutions. Also the official format for the coordinate and velocity submissions to IERS.

Example : Example files are available in the anonymous CODE ftp area (see Section 7.4; weekly European combined solutions as well as the weekly global solutions) or at CDDIS for different other IGS Analysis Centers. At the IGS Information Center an ASCII description of the SINEX 1.00 format is available [*Kouba et al.*, 1996].

Further Information : A milestone for the development of the SINEX format was the 1994 IGS Workshop on the *Densification of the IERS Terrestrial Reference Frame through Regional GPS networks* (JPL, Pasadena, Dec. 1994). There it was decided to start an IGS pilot project to prove the concept for a *distributed processing* of GPS data.

A test format of a Software INdependent EXchange format (SINEX Version 0.05) [1995], was defined by a working group. The SINEX format contains — besides the coordinate estimates and the corresponding covariance information — other important information like site names, DOMES numbers, antenna types, antenna eccentricities, phase center values, receiver types, and information on a priori weights (a priori values and a priori covariance matrix). Now the "final" SINEX Version 1.00 [1996] is the official exchange format within the IGS for all contributions later than July 1996.

The information of the elevation-dependent antenna phase center model used is "hard-wired" in the source code of the subroutine `SINSAV`. Please change the source code (see Section 23.6) if you intend to specify a special model name.

General information is included in the SINEX files with help of a general file (see Section 24.4.9).

24.8.14 Normal Equation Rescaling File

Type : ASCII

Directory : Campaign-specific directory `OUT`.

Content : Normal equations rescaling information.

Created by : User-defined or as output of ADDNEQ (Menu 4.8.1) or SNXNEQ (no menu program).

Used by : ADDNEQ to rescale normal equations for the computation of combined solutions.

Example : Figure 24.31. Examples also available in the distribution.

Further Information : Rescaling of normal equations for the combination of solutions is usually NOT necessary, if you combine your own normal equations. If you combine solutions from different processing centers (using different program systems) rescaling the associated variance-covariance matrices may be mandatory. The example in Figure 24.31 shows the rescaling values for different European Analysis Centers (all using Bernese) [*Brockmann and Gurtner*, 1996], which were computed using the information on the sampling rate, only.

With program SNXNEQ transforming SINEX files into normal equation files (see Section 7.3.3) you may also estimate a priori rescaling values. These values are derived from comparing the rms values of the coordinate estimates of individual solutions.

The intention behind this file is to allow in future also the generation of an output file of estimated rescaling factors using the methods of *variance-covariance component estimation*. These methods are NOT activated in the present Version 4.2. Some further comments:

- The mentioned rescaling values refer to the normal equations (< 1 means down-weighting, 0.25, e.g., means down-weighting by a factor of 2 ($1/2^2 = 1/4 = 0.25$)).
- You may specify a rescaling value for each file separately by specifying `FILE NAME`s (e.g., with use of the input file list from the F-file).
- You may also specify a GRP name (please leave the `FILE NAME` blank in this case). The GRP name specified here is compared to the normal equation input file names (first 3 characters disregarding the directory path). That makes it possible to handle files in groups.
- The `NUM` column is not used, at present.
- The information of the `HELMERT PAR` enables the estimation of Helmert parameters between individual solutions (or groups of solutions) and the combined solution. We do not recommend to use this test version, at present.

```
COVARIANCE COMPONENTS
PROGRAM SNXNEQ OUTPUT - COVARIANCE COMPONENT ESTIMATION AND HELMERT PARAMETERS
-------------------------------------------------------------------------------
NUM  VALUE                 FILE NAME                         GRP HELMERT PAR.   HELMERT VALUES ....
**  ******************  ********************************  ***  * * * * * * * ******** ******** ..

 1  0.10000000000000E+01                                  COE  0 0 0 0 0 0 0   0.0000   0.0000 ..
 2  0.10000000000000E+01                                  BEK  0 0 0 0 0 0 0   0.0000   0.0000 ..
 3  0.10000000000000E+01                                  IFG  0 0 0 0 0 0 0   0.0000   0.0000 ..
 4  0.66000000000000E+00                                  ROB  0 0 0 0 0 0 0   0.0000   0.0000 ..
 5  0.16000000000000E+00                                  WUT  0 0 0 0 0 0 0   0.0000   0.0000 ..
 6  0.16000000000000E+00                                  OLG  0 0 0 0 0 0 0   0.0000   0.0000 ..
```

Figure 24.31: Normal equation rescaling (`.WGT`) file.

24.8.15 Observation Editing File

Type : ASCII

Directory : Campaign-specific directory `OUT`.

Content : Observations file editing information (outliers, cycle slips, ambiguities, etc.) information.

Created by : User-defined or as output file from RESRMS (Menu 5.3.2).

Used by : SATMRK to mark outliers according the editing file.

Example : Figure 24.32 (showing all possible options to handle observations in a specific file or in all files.

Further Information : It is recommended in the automated processing to use the program RESRMS to detect outliers in the residuals of GPSEST. The outliers found by RESRMS may then be marked in the observation files using program SATMRK (Menu 5.1 , option "`M`"). The Graphical Tool GT (see Chapter 21) also writes an observation editing file.
The example file Figure 24.32. stems **not** from the program RESRMS because the program is not able to remove totally all data (`1 - 99999`) of a particular satellite if observations are bad. It marks only a maximum number of continuous observations (to be specified in Panel 5.3.2–1 , option `DELETE DATA PIECES SMALLER THAN`), so that a little number of observations may remain for a bad satellite.

```
MANUAL TEST TO MARK OBSERVATIONS                                  19-AUG-94 10:26
-------------------------------------------------------------------------------

FILE INFORMATION:
----------------

FILE  SESS SESF  REFERENCE EPOCH   DTOBS TYPE STATION1         STATION2
-------------------------------------------------------------------------------

  1   0226  1    94-08-14  0:00:00   30   P   ALGO 40104M002   WES2 40440S020
  2   0226  1    94-08-14  0:00:00   30   P   ALGO 40104M002   YELL 40127M003B
  3   0226  1    94-08-14  0:00:00   30   P   AREQ          B  EISL 41703M003
 ..   ....  .    ........  .......   ..   .   ..............   ..............

-------------------------------------------------------------------------------

EDITING INFORMATION:
--------------------
(EDITING TYPES: MARK=1, RESET=-1, ELIM.=2, SLIP=3, NEW AMB.=4, RESET AMB.=-4,
                SET CYC.SLP. FLAG=5, RESET CYC.SLP FLAGS=-5)
                     EPOCH NUMBERS
FILE  SAT  TYPE  FRQ  START  END    SLIP SIZE  REASON  #EPOCHS
-------------------------------------------------------------------------------

 99    99   -5    3       1 99999                 1    99999
  1    99   -5    3       1 99999                 1    99999
  1     7    5    3     225                       1
  1     5    1    3     442   448                 1        7
  1     5    1    3     474   480                 1        7
  1     6   -1    2    1922  1928                 1        7
  2     1    1    3      42    48                 1        7
  2    16    3    1    2158            -234567.    1
  2    16    3    2    2158               4568.    1
 99    99   -4    3       1 99999                 1    99999
  3    99   -4    3       1 99999                 1    99999
  3    17    4    3     180                       1
  3    99    4    3     230                       1
  3    25   -4    3    2001                       1
```

Figure 24.32: Editing (`.EDT`) file.

24.8.16 Delete Files

Type : ASCII

Directory : Campaign-specific directory `OUT`.

Content : Specification which campaign-specific files (e.g., observation files, orbit files, etc.) should be deleted, when using Menu 5.8.

Created by : User-defined or created automatically using MPRXTR (Menu 5.6.3).

Used by : DELFIL_P (Menu 5.8) to delete the files specified in the delete file. This is especially well-suited for the automated processing using the BPE, but is rarely used in an interactive processing mode.

Example : Figure 24.33.

Further Information : Problematic observation files (too many ambiguities, bad triple-difference solution, etc. checked by MAUPRP) may be deleted automatically using the program MPRXTR together with program DELFIL_P.

You may also prepare a delete file manually and execute the deletion using DELFIL_P. Please note that this is sometimes quite comfortable ($-variables defined in Panel 1.5.1 and wildcards are supported).

```
$X_$Y$D1   PGMOUT
TESTFILE   CZHED
%%%%$CD1   STDORB
```

Figure 24.33: Delete (.DEL) file.

24.8.17 Summary Files

Type : ASCII

Directory : Campaign-specific directory OUT.

Content : Summaries of program output.

Created by : COMPAR (Menu 5.4.1): weekly summary file,
DEFXTR (Menu 5.6.2): summary file of ORBGEN output file,
GPSXTR (Menu 5.6.5): summary file of GPSEST and ADDNEQ output file(s),
MPRXTR (Menu 5.6.3): summary file of MAUPRP output file(s),
PREPRX (Menu 6.2): summary file of RINEX headers,
RESRMS (Menu 5.3.2): summary file of the quality of the checked observations.

Used by : The user for quality control, to have available short summary files with the most important information from different programs.

Example : Example files EXAMPLEn.SUM, n=1,8 are included in the distribution.

Further Information : -

24.8.18 Single Point Positioning File

Type : ASCII

Directory : Campaign-specific directory OUT.

Content : Contains the CODSPP summary of geocentric coordinates (.SMC) or of ellipsoidal coordinates (.SME).

Created by : CODSPP (Menu 4.2).

Used by : May be useful as a history of coordinate estimations using pseudorange observations.

Example : Figure 24.34 (example for a `.SMC` file). An example file for a `.SME` file is available in the distribution.

Further Information : The advantage of the `SMC` (and `SME`) files compared to the usual coordinate files (see Section 24.8.1) has to be seen in the circumstance that the rms information is also stored. This file type cannot be re-introduced into any other Bernese program, however. If you specify always the same file in all CODSPP runs, the new results are appended to all previous results, instead of overwriting the previous results. The maximum number of lines for this file is 10,000 lines.

```
SINGLE POINT POSITIONING SOLUTIONS: GEOCENTRIC COORDINATES IN WGS-84
-------------------------------------------------------------------

STATION NAME     SESS F FR C T I EL NS  DT   #OBS   RMS(M)        X (M)      SX(M)          Y (M)   ..
-------------------------------------------------------------------------------------------------------..

BOGO             1871 1 L3 E S N 10  1  30  17069   24.16     3633737.5551  0.5732     1397434.0088..
CAGL 12725M003   1871 1 L3 E S N 10  1  30  17794   23.90     4893377.4074  0.6725      772649.9964..
HFLK 11006S003   1871 1 L3 E S N 10  1  30  18369   24.44     4248502.3201  0.5802      855575.6391..
KIRU 10403M002   1871 1 L3 E S N 10  1  30  17168   24.15     2251419.1083  0.4398      862817.7277..
MEDI 12711M003   1871 1 L3 E S N 10  1  30  17135   24.13     4461399.6582  0.6481      919593.9116..
NOTO 12717M003   1871 1 L3 E S N 10  1  30  17981   24.08     4934527.3605  0.6760     1321262.8881..
...............
-------------------------------------------------------------------------------------------------------..
```

Figure 24.34: CODSPP summary (`.SMC`) file.

24.8.19 Meteo and Water Vapor Radiometer Data

Type : ASCII

Directory : Campaign-specific directory `ATM`.

Content : Station surface meteorological data or water vapor radiometer data.

Created by : RXMBV3 (Menu 2.7.3), GPSSIM

Used by : GPSEST as a priori troposphere information.

```
SLR                BERNESE MET.FILES FOR SLR CAMPAIGN
STATION : 8834 WETT          UTC-LOCAL TIME(HOURS) =  0 TYP= 1  #VALUES=  3  MOD=  0
  JJ MM DD HH MM SS  PPP.PP  TT.TT  HH.HH
  95 12 14 18 23 34  946.00  -3.50  84.00
  95 12 14 18 26 42  946.00  -3.50  84.00
  .. .. .. .. .. ..    ...     ...    ...
```

Figure 24.35: Meteo (`.MET`) file of type 1.

```
D: L1, DAY ALL, STA.SPE. 24/DAY ., ELE. 20                      29-DEC-94 16:36
STATION : AGAR GPS          UTC-LOCAL TIME(HOURS) =  0 TYP= 3  #VALUES=  1  MOD=  1
 JJJJ MM DD HH MM SS  CCCC.CCCC
 1994  9  6 10  0  0     1.9412
 1994  9  6 11  0  0     1.9412
 ....  .  .  .  .  .     ...
```

Figure 24.36: Meteo (.MET) file of type 3.

Example : Figures 24.35 (type 1) and 24.36 (type 3). Example files are available in the distribution.

Further Information :

- There is one meteo file per station (session-independent). The time difference between subsequent epochs is not essential. If the subroutine METEO gets a request to calculate tropospheric refraction at time T, this value is calculated by linear interpolation of the table values in this file, where the two nearest meteo recording times are used.
- File structure:
  The first record characterizes the campaign. The second record defines the station name, the difference local time - UTC (meteorological data may be recorded in local time), and the data type. The following types of meteo files are allowed:

  Type 1 : Pressure (mbar), temperature (Celsius), humidity (%).
  Type 2 : Pressure (mbar), dry temperature, wet temperature (both in Celsius).
  Type 3 : dr (m), where dr is the total tropospheric zenith delay.
  Type 4 : Tropospheric zenith delays from GPSEST or ADDNEQ (see Section 24.8.20).
  Type 5 : Pressure (mbar), temperature (Celsius), humidity (%), and zenith wet delay.
  Type 6 : Pressure (mbar), temperature (Celsius), humidity (%), and precipitable water vapor.

  The following models (mapping functions) are allowed for type 3:

  Model 0 : 1/cos(zenith angle) mapping
  Model 1 : simplified Herring mapping
- The meteo file has to end with a blank line (or a line starting with -1).
- It is also possible to include troposphere values estimated from GPS data (.TRP files according to Section 24.8.20, e.g., tropospheric estimates derived at CODE for many globally distributed GPS sites). This option is suited especially for densification purposes (distributed processing according to Section 18.4). The .TRP files may directly be used as input for GPSEST. To create the station-specific meteo files from .TRP files the program PRPMET may be used (not menu-supported).

- It would be desirable to have a program converting .TRP files into RINEX meteo files, to distribute troposphere zenith delay estimates derived from GPS in a software-independent format. Such a program does not exist at present (not supported by program RXMETEO).

24.8.20 Troposphere Parameter File

Type : ASCII

Directory : Campaign-specific directory ATM.

Content : Tropospheric zenith delays (estimated).

Created by : GPSEST (Menu 4.5),r ADDNEQ (Menu 4.8.1), or ADDNEQ2.

Used by : GPSEST (the files may be introduced as known into the processing of other (smaller) networks as a priori troposphere information), non-menu program PRPMET (conversion to meteo files .MET; see previous section).

Example : Figure 24.37. Example files are available in the distribution.

Further Information : The troposphere files contain the following information:

(1) Title.
(2) a priori model (SAASTAMOINEN = -1, HOPFIELD (REMONDI) = -2, ESSEN + FROOME = -3, SAASTAMOINEN DRY PART ONLY = -11, HOPFIELD DRY PART ONLY = -12) which was used to correct for the main effect of the tropospheric delay (see also the standard atmosphere model definition in the CONST. file of Section 24.4.1).
The positive model numbers (1 up 12) correspond to the same models but with *observed* meteorological values used for the computation of the a priori troposphere zenith delay.
(3) Station name.
(4) Station flag (see Section 24.8.1).

```
ADDNEQ: 3-DAY 211, AMB. FIXED, POLE: 2 PAR/3 DAYS ABS            03-AUG-96 06:36
-------------------------------------------------------------------------------------------------------
 A PRIORI MODEL:   -1

     STATION      FLG   JJJJ MM DD HH MM SS   JJJJ MM DD HH MM SS    MODEL   CORR. SIG_CORR  TOTAL

 KOSG 13504M003    W    1996  7 28 23 59 56   1996  7 29  6  0  0   2.3725  0.0948  0.0008  2.4673
 KOSG 13504M003    W    1996  7 29  6  0  0   1996  7 29 12  0  0   2.3725  0.0945  0.0008  2.4670
 KOSG 13504M003    W    1996  7 29 12  0  0   1996  7 29 17 59 59   2.3725  0.0970  0.0007  2.4695
 KOSG 13504M003    W    1996  7 29 17 59 59   1996  7 30  0  0  3   2.3725  0.0945  0.0009  2.4670
 ZIMM 14001M004    M    1996  7 28 23 59 56   1996  7 29  6  0  0   2.0957  0.1172  0.0011  2.2129
 ZIMM 14001M004    M    1996  7 29  6  0  0   1996  7 29 12  0  0   2.0957  0.1066  0.0012  2.2023
 ZIMM 14001M004    M    1996  7 29 12  0  0   1996  7 29 17 59 59   2.0957  0.1012  0.0012  2.1968
 ZIMM 14001M004    M    1996  7 29 17 59 59   1996  7 30  0  0  3   2.0957  0.1245  0.0013  2.2201
```

Figure 24.37: Troposphere estimates in .TRP file format.

(5) Time window.
(6) Zenith delay (total effect) from the a priori model (zero, if observed meteo used) in m.
(7) Estimated value (correction to the a priori zenith value) in m.
(8) Estimated formal rms of the correction in m.
(9) Total zenith delay (sum of a priori value and estimated correction) in m.
(10) Total delay in m (in geocentric coordinate components X, Y, Z (not displayed in Figure 24.37).

24.8.21 Tropospheric SINEX File

Type : ASCII

Directory : Campaign-specific directory `ATM`.

Content : Station-specific total zenith path delay estimates (*no* gradient information) and, optionally, station coordinates.

Created by : ADDNEQ (Menu 4.8.1) and ADDNEQ2 (Menu 4.8.3).

Used by : Exchange format internationally adopted.

Example : Figure 24.38. Example file also available in the distribution.

Further Information : The interested user of the *Bernese GPS Software* is referred to Chapter 12, in particular to Sections 12.7 and 12.8. Details on the *tropospheric*

```
%=TRO 0.00 COD 98:267:38099 COD 98:257:00000 98:258:00000 P MIX
*
+TROP/DESCRIPTION
*_________KEYWORD_____________ __VALUE(S)_____________________________________
 SAMPLING INTERVAL                              180
 SAMPLING TROP                                 7200
 TROP MAPPING FUNCTION         DRY NIELL
 ELEVATION CUTOFF ANGLE                          10
 SOLUTION_FIELDS_1             TROTOT STDDEV
-TROP/DESCRIPTION
*
+TROP/STA_COORDINATES
*SITE PT SOLN T __STA_X_____ __STA_Y_____ __STA_Z_____ SYSTEM REMRK
 CAS1  A    1 P  -901776.173  2409383.400 -5816748.431 ITRF96 CODE
 MCM4  A    1 P -1311703.245   310815.072 -6213255.119 ITRF96 CODE
 CHAT  A    1 P -4590670.958  -275482.938 -4404596.735 ITRF96 CODE
...
 JOZE  A    1 P  3664940.296  1409153.776  5009571.325 ITRF96 CODE
 KIRU  A    1 P  2251420.903   862817.164  5885476.622 ITRF96 CODE
 KOSG  A    1 P  3899225.232   396731.843  5015078.358 ITRF96 CODE
-TROP/STA_COORDINATES
*
+TROP/SOLUTION
*SITE ___EPOCH____ TROTOT STDDEV
 CAS1 98:257:03600 2249.7    0.8
 CAS1 98:257:10800 2247.0    0.8
 CAS1 98:257:18000 2248.3    1.0
...
 KOSG 98:257:68400 2413.8    0.7
 KOSG 98:257:75600 2419.8    0.6
 KOSG 98:257:82800 2420.9    0.7
 TROP/SOLUTION
*
%=ENDTRO
```

Figure 24.38: Tropospheric SINEX (`.TRO`) file.

SINEX format may be gathered from `ftp://igscb.jpl.nasa.gov/igscb/data/format/sinex_tropo.txt`, the current version of the format specifications.

24.8.22 Ionosphere Models

Type : ASCII

Directory : Campaign-specific directory `ATM`.

Content : Ionosphere models (represented by sets of total electron content (TEC) parameters).

Created by : IONEST (Menu 4.7, model type 1 only) and GPSEST (Menu 4.5, model type 1 *not* supported by the menu system).

Used by : MAUPRP (Menu 4.4.2), GPSEST (Menu 4.5), IONINX, GPSSIM.

Example : Figure 24.39 (model type 1), Figure 24.40 (model type 2), and Figure 24.41 (model type 3). Example files also available in the distribution.

Further Information : We support three types of ionosphere models:

Type 1 : *Local* ionosphere models (see Section 13.4.1.3) may be generated and used in the following way: estimated by program IONEST (processing zero-difference L_4 observations) and introduced into programs MAUPRP and GPSEST. We do not recommend to estimate ionosphere models of type 1 using GPSEST, because this feature is not supported by the menu system. The estimation of local ionosphere parameters has to be activated there "manually" via the I-file. Moreover, you have to define the model parameters by specifying an a priori `.ION` file of type 1 (origin of development, applicability window, the other parameters may be copied from an arbitrary `.ION` file of type 1).

Type 2 : *Global/regional* ionosphere models (see Section 13.4.1.4) may be created much easier using GPSEST. The corresponding parameter type to be solved for may be specified directly in Panel 4.5–2.4 and Panel 4.5–2.4.C, respectively.

Type 3 : *Station-specific* ionosphere models are treated exactly in the same way as global/regional models. One full set of ionosphere parameters is set up with respect to each station involved, however.

More information concerning ionosphere models is given in Chapter 13.

```
IONOSPHERE MODELS FOR TURTMANN                                        8-FEB-93 10:59
--------------------------------------------------------------------------------
IONOSPHERE MODEL NUMBER                          :    1
TYPE OF IONOSPHERE MODEL                         :    1
ORIGIN OF DELEVOPMENT: TIME (UT)  (Y M D H)      : 1992 10 28 14.8
                       LATITUDE   (DEGREES)      :   46.8771
                       LONGITUDE  (DEGREES)      :    7.4651
                       HEIGHT OF LAYER (KM)      :  350
DEGREE OF DEVELOPMENT: TIME                      :    2
                       LATITUDE                  :    1
                       MIXED                     :    2
NORMALIZATION FACTORS: LATITUDE (DEGREES)        :   6.00
                       TIME (HOURS)              :   2.00
                       ELECTRON CONTENT          :       0.10D+18
APPLICABILITY          FROM EPOCH                : 1992 10 28 12.0
                       TO EPOCH                  : 1992 10 28 17.5
COEFFICIENTS:
DEG. LAT   DEG. TIME  COEFFICIENT        RMS
    0         0        0.26313868E+01   0.18961230E-01
    0         1       -0.11226929E+01   0.82974723E-02
    0         2        0.90513909E-02   0.10480726E-01
    1         0       -0.53071964E+00   0.10746679E-01
    1         1        0.88148393E-01   0.15985126E-01
   -1
...
```

Figure 24.39: Ionosphere (`.ION`) file of model type 1.

```
CODE: GLOBAL IONOSPHERE MODEL FOR DAY 073, 1996                  17-MAR-96 04:30
--------------------------------------------------------------------------------
IONOSPHERE MODEL NUMBER                          : 0731-00
TYPE OF IONOSPHERE MODEL (1=LOCAL,2=GLOBAL)      :    2
MAXIMUM DEGREE OF SPHERICAL HARMONICS            :    8
MAXIMUM ORDER                                    :    8
DEVELOPMENT WITH RESPECT TO
  GEOGRAPHICAL (=1) OR GEOMAGNETIC (=2) FRAME    :    1
  MEAN (=1) OR TRUE (=2) POSITION OF THE SUN     :    1
MAPPING FUNCTION (1=1/COS)                       :    1
HEIGHT OF SINGLE LAYER AND ITS RMS ERROR (KM)    :  400.00     0.00
COORDINATES OF EARTH-CENTERED DIPOLE AXIS
  LATITUDE OF NORTH GEOMAGNETIC POLE (DEGREES)   :
  EAST LONGITUDE (DEGREES)                       :
PERIOD OF VALIDITY
  FROM EPOCH / REFERENCE EPOCH (Y,M,D,H,M,S)     : 1996 03 13 00 00 00
  TO EPOCH                                       : 1996 03 13 23 59 59
LATITUDE BAND COVERED
  MINIMUM LATITUDE (DEGREES)                     :  -85.75
  MAXIMUM LATITUDE (DEGREES)                     :   87.09
ADDITIONAL INFORMATION
  NUMBER OF CONTRIBUTING STATIONS                :   64
  TID INDICATOR (TECU)                           :    0.99
COMMENT / WARNING                                :
COEFFICIENTS
DEGREE  ORDER    VALUE (TECU)   RMS (TECU)
   0       0      10.66643935     0.0322
   1       0      -0.98758858     0.0310
   1       1       4.64559206     0.0307
...
   8      -7       0.08463739     0.0090
   8       8       0.04962560     0.0100
   8      -8       0.06239174     0.0105
```

Figure 24.40: Ionosphere (`.ION`) file of model type 2.

```
CODE'S STATION-SPECIFIC IONOSPHERE INFO FOR DAY 043, 2001       15-FEB-01 22:35
--------------------------------------------------------------------------------
MODEL NUMBER / STATION NAME                     : ALIC 50137M001
MODEL TYPE (1=LOCAL,2=GLOBAL,3=STATION)         :    3
MAXIMUM DEGREE OF SPHERICAL HARMONICS           :    6
MAXIMUM ORDER                                   :    6
DEVELOPMENT WITH RESPECT TO
  GEOGRAPHICAL (=1) OR GEOMAGNETIC (=2) FRAME   :    2
  MEAN (=1) OR TRUE (=2) POSITION OF THE SUN    :    1
MAPPING FUNCTION (0=NONE,1=1/COS)               :    1
HEIGHT OF SINGLE LAYER AND ITS RMS ERROR (KM)   :  450.00     0.00
COORDINATES OF EARTH-CENTERED DIPOLE AXIS
  LATITUDE OF NORTH GEOMAGNETIC POLE (DEGREES)  :   79.00
  EAST LONGITUDE (DEGREES)                      :  -71.00
PERIOD OF VALIDITY
  FROM EPOCH / REFERENCE EPOCH (Y,M,D,H,M,S)    : 2001 02 12 00 00 00
  TO EPOCH                                      : 2001 02 12 23 59 59
LATITUDE BAND COVERED
  MINIMUM LATITUDE (DEGREES)                    :  -43.89
  MAXIMUM LATITUDE (DEGREES)                    :  -20.97
ADDITIONAL INFORMATION
  NUMBER OF CONTRIBUTING SATELLITES             :   28
  ELEVATION CUT-OFF ANGLE (DEGREES)             :   10
  MAXIMUM TEC AND ITS RMS ERROR (TECU)          :   93.70     4.68
COMMENT / WARNING                               :
COEFFICIENTS
DEGREE  ORDER    VALUE (TECU)   RMS (TECU)
   0       0      263.76394413   109.5912
   1       0      -86.24873600   119.5143
   1       1       57.74971690   105.9182
...
   6      -5       -3.03749549     0.6371
   6       6        0.72545495     0.1393
   6      -6        0.05605763     0.1410

...
```

Figure 24.41: Ionosphere (`.ION`) file of model type 3.

24.8.23 Ionosphere (IONEX) Maps

Type : ASCII

Directory : Campaign-specific directory `ATM`.

Content : Earth-fixed grid maps (snapshots) of total electron content (TEC) values (and of associated rms errors, optionally). Differential (P1-P2) code bias (DCB) values related to GPS/GLONASS satellites may be included as well (see also Section 24.8.26).

Created by : GPSEST (Menu 4.5), IONINX, DCBINX.

Used by : Exchange format internationally adopted. The following programs of the *Bernese GPS Software* make use of the IONEX format: DCBINX, INXDCB, INXDIF, INXTST.

Example : Figure 24.42. Example file also available in the distribution.

Further Information : More information concerning the *IONosphere map EXchange (IONEX)* format may be found in Section 24.4.10 and in Chapter 13. The interested user is finally referred to the IONEX format specifications [*Schaer et al.*, 1998].

```
     1.0            IONOSPHERE MAPS     GPS                 IONEX VERSION / TYPE
GPSEST V4.1         AIUB                24-SEP-97 01:21     PGM / RUN BY / DATE
CODE'S EUROPEAN IONOSPHERE INFORMATION FOR DAY 256, 1997    COMMENT
The European ionosphere maps are generated on a daily basis DESCRIPTION
by the Center for Orbit Determination in Europe (CODE),     DESCRIPTION
University of Berne, Switzerland.                           DESCRIPTION
...
  1997     9    13     0     0     0                       EPOCH OF FIRST MAP
  1997     9    14     0     0     0                       EPOCH OF LAST MAP
  3600                                                     INTERVAL
    25                                                     # OF MAPS IN FILE
  COSZ                                                     MAPPING FUNCTION
    15.0                                                   ELEVATION CUTOFF
Doubly differenced GPS carrier phase                       OBSERVABLES USED
    32                                                     # OF STATIONS
    26                                                     # OF SATELLITES
  6371.0                                                   BASE RADIUS
     2                                                     MAP DIMENSION
   400.0 400.0   0.0                                       HGT1 / HGT2 / DHGT
    75.0  30.0  -2.5                                       LAT1 / LAT2 / DLAT
   -25.0  45.0   2.5                                       LON1 / LON2 / DLON
    -1                                                     EXPONENT
TEC/RMS values in 0.1 TECU; 9999, if no value available    COMMENT
                                                           END OF HEADER
     1                                                     START OF TEC MAP
  1997     9    13     0     0     0                       EPOCH OF CURRENT MAP
    75.0 -25.0  45.0   2.5 400.0                          LAT/LON1/LON2/DLON/H
   48   49   49   49   49   49   49   49   50   50   50   50   50   50   50   50
   50   50   50   50   50   50   50   49   49   49   49   49   50
    72.5 -25.0  45.0   2.5 400.0                          LAT/LON1/LON2/DLON/H
   41   41   41   41   41   41   41   41   42   42   42   42   41   41   41   41
   41   41   41   41   41   41   41   41   41   41   41   41   41
    70.0 -25.0  45.0   2.5 400.0                          LAT/LON1/LON2/DLON/H
   34   34   34   33   33   33   33   33   33   33   33   32   32   32   32   32
   32   32   32   31   31   31   31   31   31   31   31   31   31
...
    35.0 -25.0  45.0   2.5 400.0                          LAT/LON1/LON2/DLON/H
   11   11   11   11   11   11   11   11   11   11   10   10   10   10   10   10
   10   10   10   10   10   10   10   10   10   10   10    9    9
    32.5 -25.0  45.0   2.5 400.0                          LAT/LON1/LON2/DLON/H
   13   13   13   13   13   13   13   13   13   13   12   12   12   12   12   12
   12   12   12   12   12   12   12   12   12   12   11   11   11
    30.0 -25.0  45.0   2.5 400.0                          LAT/LON1/LON2/DLON/H
   16   16   16   16   16   16   16   16   15   15   15   15   15   15   15   15
   15   15   15   15   15   14   14   14   14   14   14   14   14
    25                                                     END OF RMS MAP
                                                           END OF FILE
```

Figure 24.42: Ionosphere (IONEX) map (`.INX`) file.

24.8.24 Satellite Clock Coefficients

Type : ASCII

Directory : Campaign-specific directory `ORB`.

Content : Satellite clock parameters (extracted from broadcast messages).

Created by : SATCLK (Menu 3.8) or PRETAB (Menu 3.2).

Used by : CODSPP (Menu 4.2), MAUPRP (Menu 4.4.2), GPSEST (Menu 4.5).

Example : Figure 24.43.

Further Information :

(1) In CODSPP a satellite clock file has to be specified if standard orbits are used as orbit information (no clock information stored in standard orbits).

(2) In MAUPRP and GPSEST this file is used to take into account the satellite clock corrections in the time interval between the measure-

ments of the two receivers of a baseline. It is of importance only if different receiver types are combined that measure at significantly different epochs (> 20 millisec).

(3) It is also possible to store the clocks of several sessions in one file.

See Chapter 16 for more information.

```
SATELLITE CLOCKS FROM BROADCAST FILE                          01-AUG-96 22:09
-------------------------------------------------------------------------------

SAT WEEK   TOC   #PAR     A0 (SEC)       A1 (SEC/SEC)    A2 (SEC/SEC**2)

  2  864   86400.  3  -0.276850071D-03 -0.318323146D-11  0.000000000D+00
  2  864   93600.  3  -0.276872888D-03 -0.318323146D-11  0.000000000D+00
  ...
  2  864  165600.  3  -0.277085230D-03 -0.318323146D-11  0.000000000D+00
  3  864   86400.  3   0.363565050D-04  0.375166564D-11  0.000000000D+00
  ...
```

Figure 24.43: Satellite clock (`.CLK`) file.

24.8.25 Receiver Clock Coefficients

Type : ASCII

Directory : Campaign-specific directory `ORB`.

Content : Receiver clock corrections (for simulation purposes only).

Created by : User-defined.

Used by : GPSSIM (no menu support).

Further Information : Only used for simulations.

Example : Figure 24.44.

```
RECEIVER CLOCKS AS POLYNOMIALS OF DEGREE N-1
POLYNOMIAL COEFFICIENTS IN SEC, SEC/DAY, SEC/DAY**2,...
 STATION        N     A0       A1       A2       A3       A4       A5
ZIMMERWALD      6 +0.016017-0.000123+0.000222-0.002000-0.012345+0.000555
CHASSERAL       6 -0.003002+0.001234-0.000000+0.010000-0.034556-0.023476
GENEROSO        6 +0.020000-0.010000+0.010000-0.005045-0.000345-0.123456
TITLIS          6 -0.013000+0.020000-0.001234+0.001000-0.006000-0.500000
```

Figure 24.44: Receiver clock corrections (for simulation only).

24.8.26 Differential P1-P2 Code Biases for Satellites and Receivers

Type : ASCII

Directory : Campaign-specific directory `ORB`.

Content : Differential P1-P2 code bias (DCB) values for GPS/GLONASS satellites and receivers.

Created by : GPSEST (Menu 4.5), INXDCB.

Used by : GPSEST (Menu 4.5), DCBINX, IONINX, GPSSIM.

Example : Figure 24.45.

Further Information : GPS-related DCB values are indicated by a leading "`G`", GLONASS-related values by a leading "`R`". If such an indicator is missing (e. g., in *old* CODE P1-P2 DCB files), the DCB information is assumed to be GPS-related. In case of GPS/GLONASS-combined receivers, *two* receiver-specific bias values are provided, one related to GPS and one related to GLONASS. Note that a bias value specific to a receiver is addressed with the corresponding station name.

More information concerning DCBs may be found in Chapter 13 or in [*Schaer*, 1999].

```
CODE'S DIFFERENTIAL CODE BIASES FOR DAY 350, 1998               21-DEC-98 17:37
--------------------------------------------------------------------------------

DIFFERENTIAL (L1-L2) CODE BIASES FOR SATELLITES AND RECEIVERS:

PRN / STATION NAME        VALUE (NS)  RMS (NS)
***   ****************    *****.***   *****.***
G01                          -0.671       0.011
G02                          -2.089       0.011
G03                           0.068       0.011
...                           .....       .....
G31                           1.143       0.012
```

Figure 24.45: Differential P1-P2 code biases for GPS satellites (`.DCB` file).

24.8.27 Antenna Height Translation Table

Type : ASCII

Directory : Campaign-specific directory `STA`.

Content : Old and new antenna heights for the transfer program RXOBV3.

Created by : User-defined.

Used by : RXOBV3 (Menu 2.7.1).

Example : Figure 24.46.

Further Information : This translation table may optionally be used in program RXOBV3. It is used if the antenna heights given in the RINEX files have to be changed to be consistent with the phase center offset values given in the phase center offset file (see Section 24.4.5) or if the RINEX files contain wrong antenna information (which may occur ...).

```
CODE: ANTENNA HEIGHT TRANSLATION TABLE                        02-APR-96  10:00
------------------------------------------------------------------------------

STATION NAME          RINEX FILE     BERNESE    (99.9999: TAKE VALUE FROM FILE)
****************       **.****       **.****
GRAZ 11001M002          2.0680        2.0680
GRAZ 11001M002B         1.9640        1.9640
GRAA 11001S007          0.0000        0.0000
HERS 13212M007          0.2002        0.2002
KOSG 13504M003          0.1050        0.1050
MADR 13407S012          0.0000        0.0000
MATE 12734M008          0.1350        0.1350
MATE 12734M008B         0.1010        0.1010
TROM 10302M003          2.4734        2.4734
WETT 14201M009          0.0000        0.0000
WTZR 14201M010          0.0710        0.0710
ZIMM 14001M004          0.0000        0.0000
```

Figure 24.46: Height translation (`.HTR`) file.

24.8.28 Ocean Loading Table

Type : ASCII

Directory : `$X/GEN` (UNIX) / `X:[GEN]` (VMS) / `X:\GEN` (DOS)

Content : Ocean loading amplitudes and phases

Created by : User-defined.

Used by : GPSEST (Menu 4.5).

Example : Values for site `ALBH` in Figure 24.47.
Example files are available in the `$X/INX` directory and in the anonymous CODE ftp area (see Section 7.4).

Further Information : This table may optionally be used in program GPSEST in order to take into account the effects due to ocean loading. The format is the “de facto” IERS standard.

```
  ALBH     40129
$$ PROV_PP ID: May   2, 1995 15:51 PTM PTM
$$ Computed by H.G.Scherneck Onsala Space Observatory, 1994
$$ 40129M003                              RADI TANG lon/lat: -123.4870   48.3895
  .01889 .00535 .00360 .00158 .01416 .00908 .00468 .00150 .00058 .00048 .00086
  .00576 .00206 .00109 .00058 .00398 .00261 .00131 .00046 .00015 .00013 .00034
  .00155 .00042 .00041 .00011 .00230 .00137 .00075 .00026 .00004 .00003 .00015
    71.7  110.0   46.8  106.7   61.1   45.9   60.1   37.8   -3.2   31.1   52.5
  -104.7  -70.6 -125.6  -74.1 -109.7 -124.1 -110.6 -132.7  160.2 -149.1 -117.8
  -178.2  161.3  156.2  158.3 -153.3 -170.1 -153.5  178.3  116.0 -138.1 -103.9
```

Figure 24.47: Ocean loading (`.BLQ`) file.

24.8.29 Baseline Definition File

Type : ASCII

Directory : Campaign-specific directory `STA`.

Content : Pre-defined baselines.

Created by : User-defined, assistance using Menu 1.5.2, or written by SNGDIF (Menu 4.3).

Used by : SNGDIF (Menu 4.3), ADDNEQ (Menu 4.8.1), and COMPAR (Menu 5.4.1).

Example : Figure 24.48. Example files are available in the distribution.

Further Information : The baseline definition file may be used in the following cases:

(1) Pre-define baselines in the program SNGDIF.
This option is useful to force program SNGDIF to form specific baselines (e.g., baselines with identical antenna types) independently of the strategy used. Possible strategies are explained in Chapter 10. It is in addition possible to store the baseline definitions created by SNGDIF. That helps a lot in the case you have, e.g., to form the same baselines for the pseudorange observations that you created for the phase observations (Melbourne-Wübbena combination in GPSEST). Another application is a combined half automatic, half manual baseline selection (e.g., to store the baselines of SNGDIF using the criterion of a maximum number of observations in a first step, to change the baselines in the file according to your wishes, and to run SNGDIF in a second iteration specifying your baseline definitions).

(2) Baseline repeatability values in the output file of ADDNEQ. If you specify a baseline definition file in Panel 4.8.1 you will get baselines repeatability results for the specified baselines in the ADDNEQ output file.

(3) Baseline repeatability values in the output file of COMPAR (works in analogy to ADDNEQ).

```
GOPE 11502M002   ZIMM 14001M004
GRAZ 11001M002B  KOSG 13504M003
HERS 13212M007   KOSG 13504M003
HERS 13212M007   MASP 31303M002C
HERS 13212M007   MADR 13407S012
JOZE 12204M001   ONSA 10402M004
KOSG 13504M003   ONSA 10402M004
KOSG 13504M003   POTS 14106M003
KOSG 13504M003   REYK 10202M001
....             ....
```

Figure 24.48: Baseline definition (`.BSL`) file.

Note: the wildcard "*" is allowed in one (or both) columns to make sure that the results of all baselines with respect to a certain station are printed (This feature is only supported by ADDNEQ).

24.8.30 Cluster Definitions (Input)

Type : ASCII

Directory : Campaign-specific directory STA.

Content : Cluster definitions to be used within SNGDIF.

Created by : User-defined. No assistance by the menu system.

Used by : SNGDIF (Menu 4.3).

Example : Figure 24.49. Example files are available in the distribution.

Further Information : Using such a file it is possible to define clusters of sites. The intention is to handle all sites within a cluster with correct correlations in program GPSEST. If the correct handling of the correlations is not required (not the highest accuracy requirements) a subdivision into clusters is not necessary. Due to memory and computer time limitations it is not possible to handle more than about 30 sites with correct correlations. If your network consists of considerably more sites, you may use the cluster definition file to form clusters of baselines with the program SNGDIF, then process the individual clusters (with correct correlations), and finally combine the cluster normal equation to a complete network solution (see, e.g., the BPE processing example of the distribution or see Chapter 4 or Section 18.4). It only makes sense to specify a cluster definition file, if you also specify a cluster definition **output** file in SNGDIF (see next section).
Note: The maximum number of clusters allowed is 100 (00-99).

```
SNGDIF: CLUSTER DEFINITION FILE                          19-APR-1995
------------------------------------------------------------------------
STATION NAME      CLU
****************  ***

BOR1 12205M002      1           ! EUROPE
HERS 13212M007      1           ! 23 STATIONS
JOZE 12204M001      1
KOSG 13504M003      1
TROM 10302M003      1
ZIMM 14001M004      1
....
STJO 40101M001      2           ! NORTH AMERICA
ALGO 40104M002      2           ! 20 STATIONS
....
KIT3 12334M001      3           ! ASIA & AFRIKA
POL2 12348M001      3           ! 22 STATIONS
....
```

Figure 24.49: Cluster definition input (.CLU) file.

24.8.31 Cluster Definitions (Output)

Type : ASCII

Directory : Campaign-specific directory `STA`.

Content : Cluster definitions to be used in connection with GPSEST.

Created by : SNGDIF (Menu 4.3).

Used by : GPSEST (Menu 4.5).

Example : Figure 24.50: European cluster (number 1) of the cluster definition file (Figure 24.49). This file has exactly the same format as the observation selection file used by the menu system (`GPSEST_P`) to select observation files. Example files are available in the distribution.

Further Information : If you specify a cluster definition input (`CLU`) file in SNGDIF (see previous section) containing, e.g., n clusters, you should also specify a cluster definition output (`CLB`) file name (e.g., `CLUST_`). SNGDIF then creates, according to the cluster numbers `cc` specified in the `CLU` file, n files with the file names `CLUST_cc`. In each of these files the baselines belonging to the cluster number `cc` are stored.
Trick: To process the observations of one cluster with GPSEST, only, copy the baseline cluster file `CLUST_cc` to your working directory (`$U/WORK` (UNIX) / `U:[WORK]` (VMS) / `U:\WORK` (DOS)) using the name `PHSFILE.SEL` (e.g., for UNIX: `cp $P/MYCAMP/OUT/CLUST_cc.CLB $U/WORK/PHSFILE.SEL`),
and then write in Panel 4.5, option `PHASE S.DIFF.: SELECTED`.

```
BOKO2111
BSKO2111
GPZI2111
GZKO2111
........
```

Figure 24.50: Cluster definition output (`.CLB`) file for one particular cluster.

24.8.32 Special Fixed (and Constrained) Station File

Type : ASCII

Directory : Campaign-specific directory `STA`.

Content : Specification of fixed sites and sites with a priori sigmas (constraints).

Created by : User-defined. Assistance using Menu 6.3.2 .

Used by : GPSEST (Menu 4.5), ADDNEQ (Menu 4.8.1), and ADDNEQ2 (Menu 4.8.3).

Example : Figure 24.51 with an example to fix sites (a) and an example to constrain sites (b). Example files are available in the distribution.

Further Information : This so-called FIX file has been developed mainly to be used in an automatic processing mode. The file may contain two types of entries:

(1) Entry to fix sites to their a priori coordinates (24.51 (a)):
This file is used in GPSEST (Panel 4.5–1, option Fixed Station(s), input SPECIAL_FILE) and ADDNEQ (Panel 4.8.1–1, option FIXED STATIONS, input SPECIAL_FILE) to fix a site to the given a priori coordinates. Keep in mind that fixing sites in GPSEST means NOT to set up any coordinate parameters for the fixed sites, whereas in ADDNEQ fixing is identical to specify a priori constraints of 0.001 mm for the site coordinates.
Only the entries in the FIX file with blank sigmas are read and the corresponding sites are fixed.

(2) Entry to constrain a site with a priori sigmas to its a priori coordinates (24.51 (b)):
This file is used in GPSEST (Panel 4.5–2, option Special Requests, input YES, (Panel 4.5–2.4, option A PRIORI SIGMAS FOR SITE COORDINATES, input YES, (Panel 4.5–2.4.B, option STATIONS, input SPECIAL_FILE) to apply a priori constraints for site coordinates (given in the local coordinate system north-east-up).
In ADDNEQ you may activate the constraint file using Panel 4.8.1–1, option A PRIORI SIGMAS, input YES, Panel 4.8.1–1.7, option STATIONS, input SPECIAL_FILE. Only the entries in the constraint (FIX) file with non-blank sigmas are read and the corresponding sites are constrained.

Note: The same FIX file may be used to fix **and** to constrain sites. The menu system only accepts one "SPECIAL FILE" for both options.

Note: The same file format is used by ADDNEQ2 in Panel 4.8.3–4A (station coordinates) and Panel 4.8.3–4B (station velocities). However, only the first sigma value belonging to each station is read by the menu system and this is applied to all three coordinates (velocities) of the corresponding station. If no station-specific sigma is given (the case of 24.51 (a)) the default value from Panel 4.8.3–4A or Panel 4.8.3–4B is used.

```
153 KOSG 13504M003
154 MADR 13407S012
156 TROM 10302M003
157 WETT 14201M009
```

(a) Entries to fix sites.

```
153 KOSG 13504M003   0.0001 0.0001 0.0001
154 MADR 13407S012   0.0001 0.0001 0.0001
156 TROM 10302M003   0.0001 0.0001 0.0001
157 WETT 14201M009   0.0001 0.0001 0.0001
```

(b) Entries to constrain sites.

Figure 24.51: Special fixed station (.FIX) file. Both entry types may also be used in the same file.

24.8.33 Special Fixed Troposphere File

Type : ASCII

Directory : Campaign-specific directory `STA`.

Content : Absolute and relative constraints for the estimation of site-specific troposphere parameters.

Created by : User-defined. Assistance using Menu 6.3.2 (about the same format as the `FIX` files of Section 24.8.32).

Used by : GPSEST (Menu 4.5).

Example : Figure 24.52.

Further Information : This so-called `SIG` file has been developed to be used mainly in an automatic processing mode (e.g., with the BPE). Instead of specifying the troposphere constraints manually for all the sites you may use option `Special Station Selection` in Panel 4.5–2.4.0 to select a `SPECIAL_FILE`. The file may contain two types of entries:

(1) Entry not to set up troposphere parameters for a site (site name and *no* absolute and relative constraints specified)
(2) Entry to constrain the troposphere parameters with absolute and relative sigmas.

The format of this file is (with the exception of the last column) identical with the `FIX` file of Section 24.8.32.

```
153 KOSG 13504M003   0.1000 0.0050
154 MADR 13407S012   0.1000 0.0050
156 TROM 10302M003   0.1000 0.0050
157 WETT 14201M009   0.1000 0.0050
453 GOLD 40405S031
454 KOKB 40424M004
458 YELL 40127M003   0.1000 0.0050
458 YELL 40127M003B  0.1000 0.0050
461 SANT 41705M003   0.1000 0.0050
551 TIDB 50103M108
```

Figure 24.52: Special troposphere (`.SIG`) file.

24.8.34 Special FTP File

Type : ASCII

Directory : Campaign-specific directory `STA`.

Content : Station names (4-character abbreviations: the first 4 characters of the RINEX file name) of the sites to be downloaded from a global IGS Data Center.

Created by : User-defined. Assistance using Menu 6.3.1 or output file of the RINEX check program Menu 6.5.2.

Used by : FTP script preparation Menu 2.0.1.

Example : Figure 24.53.

Further Information : FTP scripts (the FTP script names are defined in Menu 0.4.1) are available (for UNIX systems only) to download RINEX observation files by FTP from a global IGS Data Center. See also Menu 2.0.2 to download IGS precise orbits automatically. To download other important informations (not supported by the menu system yet) see Section 7.4.

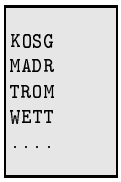

Figure 24.53: Special FTP (`.FTP`) file.

24.8.35 Receiver Antenna Orientation File

Type : ASCII

Directory : Campaign-specific directory `STA`.

Content : Receiver antenna orientations.

Created by : User-defined.

Used by : Program GPSEST.

Example : Figure 24.54.

Further Information : The antenna orientation file contains the azimuth of the antenna orientations for each session, where any of the antennas was not oriented to the north. This file is of special use if you have to process antenna calibration campaigns, where the antennas were oriented differently from session to session. The file contains receiver and antenna name, antenna number, session number, and the orientation of the antenna (azimuth in degrees). Note that an entry is only considered if the specified session number corresponds to the session number given in the header of the observation file. If no antenna orientation file is specified, a default orientation of all antennas to the north (azimuth of 0) is assumed.

```
RECEIVER ANTENNA ORIENTATIONS                                          01-JAN-01
------------------------------------------------------------------------------

RECEIVER TYPE          ANTENNA S/N   SESS  AZIMUTH
ANTENNA  TYPE          FROM    TO           DEG
********************  ****** ******  ****    ***

LEICA SR9500             101    101  2800    180
LEICA AT501

LEICA SR9500             125    125  2800    180
LEICA AT502

LEICA SR9500          730045 730045  2800    180
LEICA AT503
```

Figure 24.54: Antenna orientation (`.AZI`) file.

24.9 Program-Specific Files

We mentioned already in the introduction to this chapter, that we will not put much emphasis on the program-specific files, because they have a more technical meaning for the user. The menu programs (see Chapter 3) write into these files all necessary information (options, file names, etc.) needed to start the GPS main programs.

Table 24.2: Program-specific files.

Name	Content
N-file	Table to access general file names
F-file	File containing list(s) of observation file names
I-file	Program options
M-file	File containing list of meteo file names (GPSEST only)
T-file	Text file (GPSEST only)

Table 24.2 lists the program-specific files. Skeleton files in the directory `SKL` (see Figure 24.1) with the extension `SKL` are used by the menu system as templates to generate those files. The I-, N-, and F-files are generated in the user-specific input directories (`INP`) with the extension `.INP`. The names of the program-specific files are composed in the following way: `pgmnamX.INP`, where `pgmnam` stands for the 6-character name of the program and `X` for either “I”, “N”, or “F”.

N-file : is important to access file names (*general* files, input and/or output file names). All the files used in the *Bernese GPS Software* Version 4.2 are accessed through an N-file of the above type. There is one exception, however: the N-file itself never shows up in the file list – the problem is related to the philosophical question of the “set of all sets” ....
N-files are program-specific and computer system dependent.

F-file : contains one or more rows of file names of the same type (e.g., observation file names, orbit file names, etc.) that cannot be included in the N-file. In a few cases (as the F-file of GPSEST) some file-dependent options are also specified in the F-file.

I-file : contains the program options.

M-file : contains names of the meteo files to be included in a GPSEST run (there may be more meteo files defined here than actually used in the program).

T-file : contains most of the text to be printed during a program run. The idea: translation of the text files would allow a program output file in a different language (only realized for GPSEST).

25. Installation Guide

25.1 Installation Guide for the PC-Version

25.1.1 Overview

Bernese GPS Software Version 4.2 is prepared to be installed under PC's running MS-Windows 9x (95/98/98SE, **not** Me) or MS-Windows NT operating systems. Only minor settings have to be adapted to account for the different Windows versions. This version is also called "DOS"-version, since it runs in the DOS environment of the Windows operating systems. The *Bernese GPS Software* Version 4.2 is distributed in two different ways, either on CD-ROM (containing also the executables), or per FTP-download (source only). The installation is slightly different depending on the way the software is obtained.

Previous versions of *Bernese GPS Software* were prepared to be installed on pure DOS systems, (down to DOS version 3.3) and for Lahey Fortran compilers down to Fortran 77, version 3. Since the *Bernese GPS Software* Version 4.2 contains some Fortran 90 modules, and since it is planned to use Fortran 90 as the main programming language in the future, the explicit support for compilers is now reduced to the Lahey LF90, version 4.5 up to Lahey/Fujitsu LF95 compilers.

This chapter gives the necessary installation instructions and points out the adaptations for the different Windows operating systems and compiler versions.

25.1.2 Hardware Requirements

The *Bernese GPS Software* will run on any PC with sufficient RAM and Disk space. No special hardware requirements (e.g. graphic cards, CPU speed, etc.) exist. For requirements posed by the compiler software, please consult your compiler's User Manual.

As a general rule, it can be said that a system running one of the MS Windows operating systems (Win9x/NT) will also be sufficiently performant to run *Bernese GPS Software* Version 4.2

- CPU:

  Even though Bernese would run on old Intel 386 processors, the Pentium generation processors with high clock rates are recommended.

- RAM:

  The standard distribution of *Bernese GPS Software* has been tested using 48 MB of RAM. We recommend 64 MB of RAM as lower limit.

- Hard disk:

  The unpacked Bernese installation occupies about 200 MB of disk space. You can have the software and your data on one sufficiently large disk, or keep the software and data on separate disks.

- Swap space:

  Swap space, or *virtual memory* in Windows terminology, might be an issue. You should have at least 250 MB of swap disk space available.

25.1.3 Software Requirements

The only software requirements concern the operating system and the compilers.

25.1.3.1 Operating System

The operating system of your computer should be MS-Windows 9x (95, 98, 98SE) or NT (V4.0). Future versions of MS-Windows will be tested as they become available, and the installation instructions will be adapted accordingly.

The *Bernese GPS Software* Version 4.2 would also run on pure DOS systems, however, the explicit support has been omitted. Necessary adaptations would have to be made by the user.

25.1.3.2 Compilers

The tested compilers are the Lahey LF90 V4.5 and up, and Lahey/Fujitsu LF95 compilers. It must be noted, that the LF95 compiler cannot be used to compile the *Bernese GPS Software* Version 4.2 under Windows NT. This is due to missing ANSI support for LF95 generated programs under Windows NT. This support is required to run the Menu system of Bernese.

It is important to note that the executables contained on the CD-ROM are created using the LF90 compiler. Users wishing to compile the software with the LF95 compiler must be aware that LF90 and LF95 are not binary compatible. This means that object modules (libraries) and binary data files are not compatible between the two compiler versions. LF95 users must, therefore, delete any existing object libraries and recompile the complete software using the COMPLINK script. Users must also be aware that binary data files written by LF90 Bernese programs cannot be read by the same programs compiled with LF95 (and vice versa). Lahey does provide conversion programs for binary data files. See your Lahey documentation for more details.

25.1.4 Configuration of the DOS Environment

Before installing the *Bernese GPS Software* Version 4.2 the DOS environment of your Windows system needs to be prepared. The procedure is similar on the different Windows systems. Differences are pointed out when necessary:

25.1.4.1 System Configuration Files CONFIG.SYS and CONFIG.NT

First, check that **ANSI.SYS** is loaded in your **CONFIG.SYS** (for Win9x), **CONFIG.NT** (for Windows NT) file (the command `mem` lists the loaded drivers in your DOS box). The driver can be loaded using a command like:

```
DEVICE = C:\ANSI.SYS
```

or wherever ANSI.SYS is located on your system. The ANSI.SYS driver is only loaded after an initial reboot of your system. A very basic CONFIG.SYS file might contain the following entries:

```
DOS=HIGH,UMB
DEVICE=C:\WINNT\SYSTEM32\HIMEM.SYS
DEVICE=C:\WINNT\SYSTEM32\ANSI.SYS
FILES=100
```

25.1.4.2 Drive Letter Substitution

Bernese makes use of the substitution of pathnames by drive letters using the SUBST command. The following substitutions are made:

- `SUBST I: C:\BERN42\LIB\INCLIB42\FOR`
- `SUBST P: C:\BERN42\CAMPAIGN`
- `SUBST T: C:\BERN42\BPETEMP`
- `SUBST U: C:\BERN42\GPSUSER`
- `SUBST X: C:\BERN42\GPS42`

Make sure that these drive letters are free on your system. You can get a list of the substituted drives on your system by entering `SUBST` at a DOS command prompt. The substitutions for Bernese are made in the LOADGPS.BAT file.

25.1.4.3 Creation of a DOS Window Under Windows 9x Systems

In order to create a new DOS window under your Windows 9x system, proceed as follows:

- click the right mouse button ($\Rightarrow$ sub-menu) on the desktop
- select “new”
- select “shortcut”
- enter into COMMAND LINE field: `C:\WINDOWS\COMMAND.COM`
- select “continue”
- enter a name for this new window e.g "BGPS4.2"
- select “finish”
- click the new icon with the right mouse button ($\Rightarrow$ sub-menu)

- select “properties”
- select “program” and enter the following values into the corresponding fields:

  First field: Text of your choice
  Cmd line: `C:\WINDOWS\COMMAND.COM`
  Working: `C:\`
  Batch file: `C:\BERN42\GPS42\EXE\LOADGPS.BAT`
  Shortcut key: `None`
  Run: `Normal Window`

  Do not set any of the “Advanced...” options (and verify, that none are set!).
  Specifying LOADGPS.BAT in the “Batch file” line, will execute LOADGPS automatically, whenever this DOS window is opened. This might be convenient, but is not required.
- select “Memory” and select the following values:
  - Conventional memory:

    Total: `auto`
    Initial Environment: `4096`
    Protected: yes
  - Expanded (EMS) memory:

    Total: `Auto`
  - Extended (XMS) memory:

    Total: `None`
    Uses HMA: yes
  - MS-DOS protected-mode (DPMI) memory:

    Total: set to maximum value

The setting for the “Initial Environment” is important! All the other memory settings can be set to “Automatic”, or to the values given above.

No special remarks are given here as regards the installation of the compilers. For Lahey systems, the standard installation procedure does all that is necessary in order to compile Bernese.

25.1.4.4 Creation of a DOS Window Under Windows NT Systems

In order to create a new DOS window under your Windows NT system, proceed as follows:

- click the right mouse button ($\Rightarrow$ sub-menu)
- select “new”
- select “Shortcut”
- enter into COMMAND LINE field: `C:\WINNT\SYSTEM32\CMD.EXE`
- select “Next”
- enter a name for this new window e.g "BGPS4.2"
- select “finish”

No other settings (e.g., “Memory”) are necessary. This procedure creates a DOS Window icon on the desktop. LOADGPS will not be executed automatically.

25.1.5 Installation of the *Bernese GPS Software* Version 4.2

After having prepared the DOS Environment on your computer, you are ready to install the software. The installation is different depending on how you obtained the distribution. Unless otherwise indicated, the installation is identical on Win9x and NT systems.

25.1.5.1 Installation From CD-ROM

The installation procedure for *Bernese GPS Software* obtained on CD-ROM is straight forward:

- insert the CD in your drive
- in the DOS window, change to the CD drive
- read the " Readme" files
- start the installation by entering `INSTALL` at the command line. This script will install the software to `C:\BERN42`. If you want to install to a different drive/directory, you can specify this as parameter to the installation script. If, e.g., you want to install to `D:\test\BERN42`, then start the installation by entering `INSTALL D:\test`. Note that `BERN42` as the top directory for the *Bernese GPS Software* directory structure cannot be changed.

The installation script unzips the software and copies it to your hard disk. No further user interaction should be necessary. If a file is already present, you will be prompted for permission to overwrite it (which you should do). After this step, you can proceed to adapt the software settings according to your system. Please see Section 25.1.6 further down.

25.1.5.2 Installation of ftp Version

It is assumed that you already downloaded the software, and the distribution files reside in your temporary directory (recommended is `GPS42TMP`). You should have received instructions for the download per email. You can always request them from us.

- change to your temporary directory containing the distribution
- read the "Readme" files
- start the installation by entering `STARTINS` at the command line. This script will unzip and copy the files to `C:\BERN42` per default. If you wish to install to a different drive/directory, you can specify this as parameter to the installation script (e.g. `STARTINS D:\test`).

25.1.6 Configuration of the Software Before Running it

Before actually using the software, you will have to set/verify a few settings in 2 files:

25.1.6.1 Loading the Environment: File LOADGPS.BAT

The file LOADGPS.BAT in the BERN42\GPS42\EXE directory contains some settings in the first part of the file, clearly marked as "user editable". Please take note of the comments in this file.

- OPSYS should be set according to your Windows version. This variable is used for a few operating system dependent tasks. The default is for a Windows NT system. Possible settings are WINNT (for Windows NT) and WIN95 for Windows 95/98.

- The variable CMP_CMD should be set according to the compiler you use, it contains the command to invoke the compiler. Please note, that only the Lahey LF90 and LF95 compilers are explicitly supported. If you use another compiler, you will have to find out yourself, what the correct setting is. The default is Lahey LF90.

- The variable DRV needs only to be changed if you installed to another drive than C:. You must also specify the path, if it is different from the default, e.g., if you installed to D:\test\BERN42, set the DRV variable as follows: set DRV = D:\test. The default is C: Usually, no other settings need to be changed.

25.1.6.2 Directory Listing Format: File FORMAT.DAT

For certain tasks, Bernese creates a listing of the contents of certain directories (e.g. for file selection tasks). Under Windows, the format of this listing differs depending on whether the dir command is invoked by the user from the command line, or by a program. In addition, the format depends also on the language of your Windows system. The format can be specified in the file I:\FORMAT.DAT. This file is heavily commented, please read the comments before changing the file. The default is for an English Windows NT system. Wrong settings in this file will be clearly signaled by Bernese programs.

After these settings have been made, it is recommended to exit the DOS window, re-enter it and execute LOADGPS again. If you have installed the CD-ROM version containing the executables, you can now start the software by entering "G" at the DOS prompt.

25.1.7 Compiling/Linking *Bernese GPS Software* Version 4.2

After the software is configured according to your system, you can compile/link the programs (if you received the software on CD-ROM, this step can be omitted). There are a few routines supplied for the compilation/linking of the whole software or parts of it. These scripts are all located in your X:\EXE directory:

NAME	DESCRIPTION	CALL
COMPLINK	Compiles and links the complete Software	`COMPLINK`
LIBCOMP	Compiles and updates libraries	`LIBCOMP` *libname* "libname" may be INC, GPS, AST, MEN, or COM
PGMCOMP	Compiles and links a complete program directory	`PGMCOMP` *pgmdir* "pgmdir" may be MAIN, BPE, or MENU
CMP	Compiles (Links) an individual Subroutine or Program	`CMP` *modulename* "modulename" is the name (without extension) of the SR or the program

We emphasize again that compilation under Windows NT is not possible with the Lahey/Fujitsu LF95 compiler! The compilation/linking of the entire software takes some time. On an old 486 you must count in hours, whereas on a modern Pentium you can expect to be finished within 10 to 15 minutes.

After the successful compilation/linking you can start the *Bernese GPS Software* Version 4.2 by typing `G` at the command prompt.

25.1.8 Hints and Tips

This section provides additional information about the configuration of the software.

25.1.8.1 User Supplied Editor and Browser

The batch file `X:\EXE\B.BAT` defines the *browser* used in the software. By default, the browser `X:\EXE\BROWSE.COM` is used. You may define your own browser by adapting the entry in the file `X:\EXE\B.BAT`.

The batch file `X:\EXE\E.bat` defines the *editor* used in the software. By default, the **MS-DOS** editor is used. You may define your own editor by adapting the entry in the file `X:\EXE\E.bat`.

25.1.8.2 Background Colors of the Data Panels

The subroutine `C:\BERN42\LIB\COMLIB42\FOR\L_DSPFLD.FOR` reads parameters for ANSI.SYS escape sequences from the file `X:\SKL\DSPFLD.OPT` in order to highlight input fields (`IHIGH=1`) and the status line (`IHIGH=2`) of data input panels and also to reset the fields to the standard background color according to user preferences. Path and name of this file are hard-wired into `I:INCL_P.FOR`. If the program does not find the file it will use "black on white" for standard and "reverse video" for highlighted display.

You may change the selected colors in the file according to your preferences, the capabilities of the screen, and in accordance with the standard background color defined in `LOADGPS.BAT`. See also comments in `DSPFLD.OPT`.

There is a program `C:\BERN42\PGM\MENU42\FOR\PANTST.FOR` you can compile and link to test the effect of any changes you did to the subroutine `L_DSPFLD.FOR` (use the test panel

X:\PAN\PANTST.PAN). The CD-ROM contains the executable PANTST.EXE in the directoy C:\BERN42\PGM\MENU42\EXE.

25.1.8.3 Individual User Subdirectories

If several people are working on the same PC you might want to have individual input option panels and program input files for each user.

You could create for each user his own master directory, say

C:\BERN42\GPSUSER\username,

by substituting a drive name:

SUBST U: C:\BERN42\GPSUSER\username,

and creating the subdirectories

U:\PAN	(user data input panels)
U:\INP	(input files for the "main" programs)
U:\OUT	(user-dependent output files)
U:\WORK	(work directory for the user)

The panel files in X:\PAN must then be copied to the individual user panel directories U:\PAN. Modify the command in LOADGPS.BAT to substitute the user directory by U:, e.g., SUBST U: C:\BERN42\GPSUSER\%1 and call LOADGPS with parameter "username". You might want to create a file UNLOADGPS.BAT in order to deallocate the substituted drives.

This will allow for interactive use of the *Bernese GPS Software* by separate users. If the BPE is to be used as well, some more directories must be provided to the users:

U:\OPT	(user options for the BPE)
U:\PCF	(user Process Control Files)
U:\SCRIPT	(scripts used by the BPE)

The contents of these directories should be copied from the corresponding directories in the X:\-tree (note that X:\USERSCPT corresponds to the U:\SCRIPT directory).

Bear in mind, however, that the individual users cannot work simultaneously with the software, using this set-up.

25.1.8.4 Upgrade From Earlier Versions to Version 4.2

The source and object code of Version 4.2 will be stored into different subdirectories than earlier versions, so there will be no conflicts.

If you have campaigns in a previous version's directory structure you still want to process, you could just include their names and paths into the new campaign list (you would then have to set the path to e.g. `C:\GPS35\`. However, the entire filename might then become long, so you should include another substitution into the file `LOADGPS.BAT`, e.g. `SUBST Z: C:\GPS35`, so that the path to the old campaigns will be just `Z:\`.

You should keep in mind, that observation files once written with the new Version 4.2 will no longer be readable using earlier versions.

25.1.9 Processing Examples

The distribution you have contains a sample campaign (DOCU42_1) which you can use to get acquainted with the software.

On our anonymous ftp we made available two examples which you can use to test the software. To download the examples use the following commands:

ftp :	`ftp ubecx.unibe.ch`
login:	`anonymous`
password:	your full e-mail address
location:	`cd aiub`
	`cd BSWUSER`
	`cd EXAMPLES`

Here you will find a file named `README.TXT` with further instructions. For accessing this directory with your internet browser, use this address:
`ftp://ftp.unibe.ch/aiub/BSWUSER/EXAMPLES/`.

25.1.10 Trouble Shooting

It is very difficult to anticipate possible errors, due to the wide range and complexity of possible applications of the software. A few problems that have occurred are given below. New users are also advised to consult the messages in the **B**ernese **S**oft**W**are **Mail**ing List (BSWMail). These messages are available on the internet at:

`ftp://ftp.unibe.ch/aiub/bswmail/`

All users of Bernese may subscribe to this list by requesting subscription at

`pierre.fridez@aiub.unibe.ch`

This is also the address to request help in case of problems with the installation or the use of *Bernese GPS Software*.

Please provide as much information as necessary in your error report. It is always better to provide too much information than too little (e.g. Windows version, compiler used, exact error messages, etc.)

Some errors are easily corrected by yourself:

Can't substitute a drive: The drive letters defined in `LOADGPS.BAT` might already be in use. You can unsubstitute the letter using the command `SUBST` *drv* `/D`, where *drv* is the drive letter.

Message ''`Out of environment space`'' after a program start: Check the memory settings of your DOS-box. Check the "virtual memory" settings of Windows. During BPE runs, this error might occur and require a re-start of your Bernese DOS session. This is due to the fact that the BPE makes heavy use of environment variables. Windows does not allow to free up the space occupied by no longer used variables. Therefore, your system might eventually run out of space, and you will have to restart your Bernese DOS session.

Message ''`Program not found`'' appears when starting a program: Check the correct path settings in the panels 0.x.

Data panels appear garbled on your screen: Check if ANSI.SYS is loaded using the command `mem/c` on the command line.

25.2 Installation Guide for the VAX-Version

25.2.1 Requirements on VAX/Alpha Systems

- VAX/Alpha Fortran Compiler
- VT-200 series terminals or compatibles. If you use other terminals you have to adjust or replace a few Fortran routines (VT200_CLRSCR, VT200_PUTSTR, VT200_DSPFLD, VT200_INPCHR).

25.2.2 Copying the Installation Files on Disk

We distribute the VAX/VMS version either via ftp or on CD-ROM. Depending on your version you have to execute one of the following tasks listed below:

25.2.2.1 CD-ROM

Please proceed as follows:

1) Create a directory of your choice that will contain all the installation files (recommended is `[.GPS42TMP]`).

Example:
```
SET DEFAULT DISK$1:[yourhome]
CREATE/DIR/VERSION_LIMIT=1 [.GPS42TMP]
```

2) Change to this "installation directory": `SET DEFAULT [.GPS42TMP]`

3) Copy the files on the CD to this directory, using ftp transfer, if necessary (regarding downloading modes, see Section 25.2.2.2).

25.2.2.2 FTP Version

It is assumed that you already downloaded the software, and the distribution files reside in your temporary directory (recommended is `[GPS42TMP]`). You should have received instructions for the download per email. You can always request them from us.

You may copy the software from our special software account to your machine. In order to make it accessible for you we have to define the corresponding permissions.

> REMARK:
>
> You only can access this software account if the necessary permissions have been set for you. Please do not try to log into this account without permissions. If you are not sure or if you have questions then please let us know.
>
> E-mail address: `pierre.fridez@aiub.unibe.ch`

ALL YOUR ACTIVITIES ARE LOGGED.

1) Create a directory of your choice on your machine that will contain all the installation files.

Example:
```
SET DEFAULT DISK$1:[yourhome]
CREATE/DIR/VERSION_LIMIT=1 [.GPS42TMP]
```

2) Change to this "installation directory": `SET DEFAULT [.GPS42TMP]`

3) Log into the software account.
Login is only possible by ftp (no interactive login will be accepted)!!

internet number:	`130.92.24.22`
user name:	`BERNESE`
password :	*"you will receive the password and other important information"*

4) Select VAX version: `CD VMS`

5) Copying ASCII files:
```
ASCII
GET README.VAX
MGET *.COM
```

6) Copying BINARY files:
```
BINARY
MGET *.BCK_Z
MGET *.EXE
```

7) Exit from ftp: `BYE`

25.2.3 Installation of all Files

Since there may be different users on your machine(s) accessing the files you should make sure that the file and directory protections are set appropriately. Most files of the *Bernese GPS Software* will only be read or executed by the users. So you should set your default protection at least to "Group = Read and Execute"`(SET PROTECTION=(G:RE)/DEFAULT)` prior to the software installation.

25.2.3.1 File `LOADGPS.COM`

In order to facilitate operation and to keep as many files installation-independent as possible a command file `LOADGPS.COM` with definitions of logicals and symbols has to be created. You take the example for this file named `LOADGPS$.COM` in your installation directory and copy it to `LOADGPS.COM` in the same directory.

Edit the file `LOADGPS.COM` and set the parameters that will be used to create the directory structure (marked between two lines of "$***$").

In the file `LOADGPS.COM` you will find the following section:

```
:
$! Need Fully Resolved Name of the User Disk
$! (Logical Name of the Disk Is DISK$GPS in this Example
$!  Do NOT REMOVE the three quotation marks nor the colon!)
$!
```

```
$!      *************************
$       DISK_NAM = """DISK$GPS:"""
$!      *************************
$!
$       USER_DISK == F$PARSE('DISK_NAM',,,"DEVICE","NO_CONCEAL")
$!
$! General directory for system-wide GPS files: X:[000000]
$! -----------------------------------------------------
$! (BERN42 Is the parent directory of the installation.
$!  If you wish to create two or more subdirectories you have to separate
$!  them by a dot e.g "LOCAL.BERN42"
$!  Do NOT REMOVE the quotation marks)
$!
$!      ***********************
$       PAR_DIR == "BERN42"
$!      ***********************
$!
:
```

The parameter DISK_NAM points to the disk where you want to install the software. The parameter PAR_DIR ("parent directory") indicates the top directory of the software installation. There are two important cases you have to distinguish concerning the parameter DISK_NAM:

- case A:

  The parameter DISK_NAM points to the *top* directory of your disk (e.g. DISK$GPS is a substitution of _12dkb300:). The software then will be installed in _12dkb300:[BERN42...] (looking at the examples given above).

- case B:

  The parameter DISK_NAM does *not* point to the *top* directory of your disk (e.g. DISK$GPS is a substitution of _12dkb300:[GPS.]). In this case the subdirectory [GPS.] would be skipped and the software therefore would be installed in _12dkb300:[BERN42...]. If in this case you would like to install the software in _12dkb300:[GPS.BERN42...] you would have to include both subdirectories in the parameter PAR_DIR. This definition then would look like this:

  ```
  $!      ***********************
  $       PAR_DIR == "GPS.BERN42
  $!      ***********************
  ```

  IMPORTANT:

  The account you use to make the installation needs the privilege to create the parent directory (e.g DISK$GPS:[BERN42]) (see remark given above).

Additional adaptations may be necessary:

In order to run the GPS programs in a batch queue of your choice you have to define special symbols (BATCH1, BATCH2, ...) for each batch queue you want to use:

```
BATCH1  ==   "SYS$FASTBATCH"
BATCH2  ==   "SYS$BATCH"
BATCH3  ==   "SYS$SLOWBATCH"
  ...
```

Later on you will just tell the programs to use numbers 1, 2, etc. (0 will indicate foreground) (see Menu 0.1 of the software).

There are also definitions for a user-supplied editor, together with section files for the editor (see 25.2.4.2):

```
E*DIT   :== EDIT/TPU/NOINIT/SECTION=X:[EXE]EVE_SECTION.TPU
B*ROWSE :== EDIT/TPU/NOINIT/SECTION=X:[EXE]EVE_SECTION.BRS
```

(All special settings (see `EVE_INIT.TPU` and `EVE_INIT.BRS`) have been saved into a section file: The call to the editor is executed much faster using `SECTION` files than `INIT` files!). The asterisks in the definition above allows you to use `E` (instead of `EDIT`) or `B` (instead of `BROWSE`).

Of course you can use any suitable editor with your personal extensions and init files.

All other definitions of logicals and symbols are installation-independent and can be taken as given.

> Do not forget to include a call to
> `disk_nam:[par_dir.GPS42.EXE]LOADGPS.COM`
> in the startup file (`LOGIN.COM`) of each user account
> to load the Bernese environment.

25.2.3.2 Installation File `BSINST.COM`

After preparing the environment you must create the full directory structure and distribute all files into the corresponding directories. All these tasks will be handled fully automatically by running the file `BSINST.COM`. In order to do this you just have to change into your installation directory and to type the following command (both FTP and CD-ROM versions):

```
@BSINST
```

25.2.4 Source Code Changes

The following changes in the source code may or may not be necessary. If they are, it is important to make the changes before compiling and linking the source code. The reason is that you have to recompile and link the entire software system in order to activate these changes.

25.2.4.1 Adjustment of the Size of Executables

The size of some mainframe programs as e.g. GPSEST, ADDNEQ heavily depend on the size of the declared arrays. All major arrays are declared using parameters of the Fortran `PARAMETER` statement in so-called "include files" or in the main programs.

Depending on the available memory or the size of the GPS networks to be processed the parameters may have to be adjusted. Three categories are proposed to the user:

SIZE_SMALL : intended for PC platforms, small networks

SIZE_MEDIUM : for workstations with medium resources, regional networks

SIZE_LARGE : for workstations with large resources, global solutions

The distribution is set to the "Large" memory model.

The parameters have to be set in the following files:

(1) General settings for several programs (using include files):

```
C:[LIB.INCLIB42.FOR]I:ADDNEQ
C:[LIB.INCLIB42.FOR]I:ADDINC
C:[LIB.INCLIB42.FOR]I:DISPLAY
C:[LIB.INCLIB42.FOR]I:MAXFLS
C:[LIB.INCLIB42.FOR]I:MAXGIM
C:[LIB.INCLIB42.FOR]I:MAXSAS
C:[LIB.INCLIB42.FOR]I:MAXSAT
C:[LIB.INCLIB42.FOR]I:MAXSTA
C:[LIB.INCLIB42.FOR]I:MAXSTC
C:[LIB.INCLIB42.FOR]I:SELECT
```

(2) Settings for special subroutines:

```
C:[LIB.GPSLIB42.FOR]ADDNOR.f
C:[LIB.GPSLIB42.FOR]DSPRES.f
C:[LIB.GPSLIB42.FOR]GTSCLK.f
C:[LIB.GPSLIB42.FOR]REDTRB.f
C:[LIB.MENLIB42.FOR]PRFSPT.f
C:[LIB.MENLIB42.FOR]STANEQ.f
```

(3) Settings for the main programs:

a) using include files

```
C:[LIB.INCLIB42.FOR]I:ADDINC  (ADDNEQ main)
C:[LIB.INCLIB42.FOR]I:GPSEST  (GPSEST)
```

b) settings in the main program

```
C:[PGM.MAIN42.FOR]CODCHK.f
C:[PGM.MAIN42.FOR]COMPAR.f
C:[PGM.MAIN42.FOR]NEQFMT.f
C:[PGM.MAIN42.FOR]SNGDIF.f
C:[PGM.MAIN42.FOR]SNXNEQ.f
C:[PGM.MENU42.FOR]RXOBV3_P.f
C:[PGM.MENU42.FOR]SERVOBS.f
```

If you change the parameter declarations after the installation procedure you have to distinguish three cases:

- Change in an include file (cases (1) and (3)a):

  You have to recompile the full source code using the command `COMPLINK`, because the include files are used by several subroutines and programs.

- Change in one of the subroutines (case (2)):

  It is only necessary to recompile the subroutine using either `CLGPSL` or `CLMENL` and after that to link the main program(s) again using the command `CLPGM`.

- Change in one of the programs (case (3)b):

  If the setting was changed in a main program it is sufficient to compile and link this program using the command `CLPGM`.

25.2.4.2 User-Supplied Editor

Some programs will access a user-supplied editor through a one-line command passed to the operating system. You may use any editor or display program that may be called with a one-line command. You may distinguish between a "browse" type of program which displays files only (without the possibility to actually change the contents of the file) and editor programs, like e.g. `TPU`. We use the `TPU` editor with a special `INIT` file to define some additional keys (like F7 and F8 for left and right scrolling).

You will have to prepare one-line commands to call the editor/browse programs (e.g. by defining it in `LOADGPS.COM`, see above). These commands have to be "hard-wired" into I:INCL_P.FOR, before you compile the menu source programs and subroutines:

Example:

```
C
C  CALL COMMAND FOR EDITOR AND BROWSE
C  (ADJUST DECLARATION TO MATCH ACTUAL LENGTH!)
C  JUST THE FILENAME OF THE FILE TO BE EDITED WILL BE ADDED
      CHARACTER EDITOR*5,BROWSE*7
      DATA EDITOR/'EDIT '/
      DATA BROWSE/'BROWSE '/
```

In this example the menu programs will create the following command line each time a file 'filnam' has to be edited or browsed:

`EDIT` 'filnam' or `BROWSE` 'filnam'

This command line is passed to the operating system to be executed. If you do not want to use a special "browse program" just use the call to the editor again or define `BROWSE` accordingly in the startup file `LOADGPS.COM` (see example in Section 25.2.3.1).

25.2.4.3 Display Mode for Data Input Panels

The subroutine C:[LIB.COMLIB42.FOR]VT200_DSPFLD.FOR defines the method how to highlight input fields (IHIGH=1), the status line (IHIGH=2) of the data input panels, and also how to reset the fields to the standard display mode. Currently we use REVERSE ON / BOLD OFF for both types of input fields and REVERSE OFF / BOLD ON as standard display mode. Please look into the header comment of VT200_PUTSTR.FOR in the same subdirectory to check the possible settings.

There is a program FM:PANTST.FOR (C:[PGM.MENU42.FOR]PANTST.FOR) you may re-link to test the effect of any changes you did to the subroutine VT200_DSPFLD.FOR, there is a test panel in X:[PAN]PANTST.PAN.

The VT200_* routines use or expect escape sequences according to the VT200 standards. If you want to use other (non-compatible) terminals you have to create corresponding routines for your type of terminal.

25.2.4.4 Campaign List

The menu system uses a campaign list with the name defined in I:INCL_P.FOR:

```
DATA CMPLST/'X:[PAN]DAT11___.PAN'/
```

If you would like to have individual campaign lists for each user you would have to change the path to U:[PAN].

25.2.5 Compiling and Linking

LOADGPS.COM defines symbols together with command files in the directory X:[EXE] to facilitate compilation and linking of the different types of source files.

COMPLINK	to compile and link the entire *Bernese GPS Software*.

After this step you start the software by typing G.

To facilitate the compile and link step for parts of the distribution you may use the following commands:

LIBCOMP MEN	to compile all subroutines in C:[LIB.MENLIB42.FOR]
LIBCOMP GPS	to compile all subroutines in C:[LIB.GPSLIB42.FOR]
LIBCOMP AST	to compile all subroutines in C:[LIB.ASTLIB42.FOR]
LIBCOMP COM	to compile all subroutines in C:[LIB.COMLIB42.FOR]

(LIBCOMP also recreates the corresponding object library.)

PGMCOMP MAIN	to compile all programs in C:[PGM.MAIN42.FOR]
PGMCOMP MENU	to compile all programs in C:[PGM.MENU42.FOR]
PGMCOMP BPE	to compile all programs in C:[PGM.BPE42.FOR]
PGMLINK MAIN	to link all programs in C:[PGM.MAIN42.FOR]
PGMLINK MENU	to link all programs in C:[PGM.MENU42.FOR]
PGMLINK BPE	to link all programs in C:[PGM.BPE42.FOR]

To compile individual modules use commands of the following list:

CMENU pgmnam	to compile files in C:[PGM.MENU42.FOR]
CMAIN pgmnam	to compile files in C:[PGM.MAIN42.FOR]
CBPE pgmnam	to compile files in C:[PGM.BPE42.FOR]
CLMENL subnam	to compile and store into C:[LIB.MENLIB42.LIB]
CLGPSL subnam	to compile and store into C:[LIB.GPSLIB42.LIB]
CLASTL subnam	to compile and store into C:[LIB.ASTLIB42.LIB]
CLCOML subnam	to compile and store into C:[LIB.COMLIB42.LIB]

Use the following commands to create individual executables:

LKMENU pgmnam	to create executables in C:[PGM.MENU42.EXE]
LKMAIN pgmnam	to create executables in C:[PGM.MAIN42.EXE]
LKBPE pgmnam	to create executables in C:[PGM.BPE42.EXE]

25.2.6 Hints and Tips

This section contains some additional possibilities to adapt the software to your personal need.

25.2.6.1 Installation of Load Modules

If you want to separate the development environment from the production environment (or if you install the load modules on a second VAX) you have to copy all .EXE files from the subdirectories C:[PGM.MAIN42.EXE], C:[PGM.MENU42.EXE], and C:[PGM.BPE42.EXE] into X:[EXE] (on the second VAX).

In this case you have to:

- change the path to the programs in the data panels

```
X:[PAN]DAT021__.PAN
X:[PAN]DAT022__.PAN
X:[PAN]DAT023__.PAN
X:[PAN]DAT024__.PAN
X:[PAN]DAT025__.PAN
X:[PAN]DAT026__.PAN
```

to X:[EXE]

- change the path to the panel programs in the option file

  X:[SKL]MENU.OPT

  to X:[EXE]

- change the path to the programs in the command files

  X:[EXE]G.COM
  X:[EXE]PRCDEF.COM
  X:[EXE]RMENU.COM
  X:[EXE]RUNGPS.COM

  and in the symbol definitions of JOB and OBS in LOADGPS.COM to X:[EXE]

25.2.6.2 Installation of the User Environment

The data input panels, the input files for the "mainframe" programs, files keeping the latest file selections and some other files are user- (or better: account-) specific. Therefore you have to create special subdirectories in the environment of each user who wants to work with the *Bernese GPS Software*. (The user environment for your account is already created by the BSINST.COM installation file).

You may use the command file X:[EXE]GPS_MAKEDIR.COM as skeleton to create the user specific environment. Please make sure to run LOADGPS before you start GPS_MAKEDIR. This file will create the user environment for the account you are logging into. Generally this file does not need to be adapted.

GPS_MAKEDIR will create the directories

U:[INP]	(input files for the "mainframe" programs)
U:[OPT]	(campaign specific data panel (used by BPE))
U:[OUT]	(user-dependent output files)
U:[PAN]	(your data input panels)
U:[PCF]	(Process Control Files (used by BPE))
U:[SCRIPT]	(script files (used by BPE))
U:[WORK]	(work directory for the user)

and copy the necessary files from the master directories X:[...] into the corresponding user directories.

The directory U:[WORK] will contain files to manually start the execution of the "mainframe" programs, keep the latest selection of observation or other files (so that you may use SELECTED in the input panels) and some scratch files. You may clean up this directory from time to time, but **do not** delete the file PCFCTL.CPU.

If you have one campaign list only (X:[PAN]DAT11___.PAN) you have to set its protection to at least G:RWE, otherwise it cannot be updated by anybody else in the group.

The path to each campaign directory is defined by the user. (We use `C:` as parent directory for the campaigns). You have to make sure that the protection of the parent directory allows the user to create the campaign subdirectories. His default protection has to allow "write access" to the newly created files by other users if others have to access the data, too. (However, working *simultaneously* on the same campaign by different users may lead to unpredictable effects).

25.2.7 Setting up the BPE

You are now ready to run the software but there are a few things which you will have to do to be able to run the BPE.

The BPE is capable of using different CPUs and different machines for what we call parallel processing. Therefore we have to tell the BPE which CPUs (machines) it can use. For this purpose you have to edit the file:

```
U:[WORK]PCFCTL.CPU
```

This file will look something like this:

```
# Process control CPU information
CPU      TRUE_NAME                       SPEED    NCPU SF   IDLE MAXJ JOBS
8******* 30**************************** 8******* 4*** 4*** 4*** 4*** 4***
CPU1     SYS$FASTBATCH                   SLOW        1  300  100    2    0
CPU2     SYS$BIGBATCH                    SLOW        1  300  100    2    0
CPUQIF   SYS$ASTROBATCH/NONOTI           FAST        1  300  100    2    0
```

Basically the only thing you have to change is the `TRUE_NAME` field and possibly the name of the batch queues defined on your system (you may use the command "`show queue`" to get a list of the batch queues available on your system or ask the system administrator for details). Please make sure that an entry `CPUQIF` exists since it is used in one of the examples. Please refer to the documentation of the BPE (see Chapter 22) for information about the meaning of the other fields in this file.

25.2.8 Processing Examples

On our anonymous ftp we made available two examples which you can use to test the software. To download these examples use the following commands:

ftp : `ftp ubecx.unibe.ch`
login: `anonymous`
password: your full e-mail address
location: `cd aiub`
`cd BSWUSER`
`cd EXAMPLES`

For access with an interenet browser, please use the following address: `ftp://ftp.unibe.ch/aiub/BSWUSER/EXAMPLES/`. Here you will find a file named `readme.txt` with further instructions. Please use the DOCU42_1 example to test the BPE and the software at the same time.

25.3 Installation Guide for the UNIX Version

25.3.1 Requirements on UNIX Systems

The general system requirements to run the *Bernese GPS Software* Version 4.2 on a UNIX platform are:

- System V Fortran 77 and Fortran 90 compiler
- System V C compiler
- System V Curses Library (C-Functions for Terminal interacting)

If you do not have System V available on your system you might not be able to use all curses functions called by the *Bernese GPS Software* (e.g., the reverse display attribute will not be available).

If you do not have a Fortran 90 compiler the new ADDNEQ2 program, its menu program, and the corresponding tools are not available. On some of the UNIX systems we have problems compiling the new ADDNEQ2 program with the Fortran 90 compiler from the operating systems. It works successfully with

- NAGWare f90 and f95 compiler on Debian Linux (kernel 2.0.34) and Solaris 2.6
- xlf90 on the AIX system (FORTRAN XL)
- f90 compiler on the Solaris 2.6 system (problems with some patches detected)
- f90 compiler on the IRIX 6.5 system

So far, the *Bernese GPS Software* Version 4.2 has been tested on the following UNIX operating Systems:

SOLARIS	Sun Workstations under Solaris 2.6*
HP_770	HP Systems with HP operating system 10.20*
IBM_AIX	IBM systems under AIX 4.1.x* and 4.2.x*
LINUX	UNIX on PC (Debian, kernel 2.0.34)
IRIX	Silicon Graphics Machine 6.3* and 6.5
DEC_OSF1	DEC Alpha Processors under OSF1 (UNIX)

* On these systems some problems using the Fortran 90 compiler were found.

We would like to thank all institutions and colleagues helping us to perform the tests.

25.3.2 Copying the Installation Files onto Disk

We distribute the UNIX version either via ftp or on CD-ROMs. Depending on the version you get you have to proceed according to one of the following two instruction parts:

25.3.2.1 CD-ROM Version

We assume that you have the necessary equipment to read CD-ROMs. The CD contains the following UNIX compressed tar files:

`readme.unx`	:	Installation guide (ASCII text file)
`INSTALL.taz`	:	Installation procedures
`ASTLIB42.taz`	:	Fortran source-code of ASTLIB42
`GPSLIB42.taz`	:	Fortran source-code of GPSLIB42
`MENLIB42.taz`	:	Fortran source-code of MENLIB42
`COMLIB42.taz`	:	Fortran and C source-code of COMLIB42
`INCLIB42.taz`	:	Include files for Fortran and C source and Fortran 90 modules
`MAIN42.taz`	:	Main programs source code
`MENU42.taz`	:	Menu system source code
`BPE42.taz`	:	BPE programs source code
`INSTEXE.taz`	:	UNIX script files placed in `$X/EXE`
`INSTGEN.taz`	:	GPS general data files `$X/GEN`
`INSTINX.taz`	:	Option file prototypes `$X/INX`
`INSTPAN.taz`	:	Menu system panel files `$X/PAN`
`INSTSKL.taz`	:	Menu system skeleton files `$X/SKL`
`INSTBDS.taz`	:	BDS scripts (platform independent scripts)
`INSTHLP.taz`	:	Menu help panels
`INSTOPT.taz`	:	Option panels for the BPE example
`INSTPCF.taz`	:	Process control files for the BPE
`INSTUSERSCPT.taz`	:	User scripts for the BPE
`INSTSCRIPT.taz`	:	General script for the BPE
`INSTDOC1.taz`	:	Menu system documentation and installation guide
`INSTDOC2.taz`	:	Menu system documentation and installation guide
`DEMO42.taz`	:	Data for the BPE example campaign

Proceed as follows:

(1) Create an installation directory on your UNIX system. We recommend to use `$HOME/gpsinst42` (we use `INSTALL` as an abbreviation in the following text).

(2) Change to this installation directory:
```
cd $HOME/gpsinst42
```

(3) Put all files from the CD-ROM to this `$INSTALL` directory using
```
cp /cdrom/* .
```
(assuming `/cdrom` is the mount point for your CD-ROM drive, ask your system manager for details).
If the CD-ROM drive is on another machine you have to transfer all files by using the *binary* mode of ftp – even if your CD-ROM is located on a DOS platform. The `*.taz` files must be transferred using *binary* mode.

(4) Make sure that the stem of all the "`*.taz`" filenames are in upper case! (E.g. `INSTALL.taz`, **not** `install.taz`)

(5) Rename the installation file `INSTALL.taz` to `install.tar.Z`:
```
mv INSTALL.taz install.tar.Z
```

(6) Uncompress the compressed installation file `install.tar.Z`:
```
uncompress install.tar.Z
```

(7) Extract the files from the installation file archive `install.tar`:

```
tar -xvf install.tar
```

25.3.2.2 FTP Version

You may copy the software from our special software account to your computer. In order to make the software accessible for you we have to define the corresponding permissions. When you ask for this you will receive a detailed description for the transfer and installation procedure.

25.3.3 Installing all Source Code and Miscellaneous Files

Please read the "readme.unx" file carefully before starting the installation procedure.

If you have extracted the files from "INSTALL.taz", you can start the automatic installation by executing the `install.sh` script file. First make sure that you are in the `$INSTALL` directory, then type the command:

`bash install.sh` or
`sh install.sh` if no "bash" is available

In addition you may specify a directory `bernhome` (e.g., `/home/gpsauto/BERN42`) where the *Bernese GPS Software* will be installed using the following command:

```
bash install.sh INST_BASE bernhome
```

This script file will:

(1) check the `$INSTALL` directory for all files. It stops if one of the installation files is missing or isn't named as expected (UNIX is case sensitive!).

(2) ask you for the following directories:

- directory for the source code (example `/home/gpsauto/BERN42`)
- directory for the user files (example `/home/gpsuser/GPSUSER42`)
- directory for temporary files (example `/home/gpsuser/GPSTEMP42`)
- up to three directories for campaigns (example `/home/gpsdata/GPSDATA_P`)

(3) ask you for the SHELL you want to use in the environment of the *Bernese GPS Software*. With IBM_AIX and IRIX you should use a Korn Shell (`ksh`), with others you may select either the Bourne (`sh`) or the Bourne Again Shell (`bash`).

(4) check your system for the name and the version of the operating system. Please confirm or edit these values.

(5) decide which compiler and which software version you want to install (Fortran 77 or Fortran 90 – Fortran 90 is a requirement for the new ADDNEQ2 program)

(6) create the `LOADGPS` file. All your entries will be set automatically in this file. In the normal case no changes will be necessary in the `LOADGPS` file. The file will be copied into your `$HOME` directory, where you can use it to get the environment for the *Bernese GPS Software*. *When you rename or move the `LOADGPS` file you also have to change the setting of the variable `$LOADGPS` in this file which contains the full path name to the `LOADGPS` file.* The `CRE_USR` script must be modified as well.

(7) create all necessary subdirectories.

(8) extract all source code from the tar files into the corresponding directories.

(9) extract all miscellaneous files into the correct directories.

(10) execute the command `LOADGPS INIT` to make all necessary links.

(11) finish its work executing the `CRE_USR` script (see Section 25.3.6.3 for more details). This script will

a) make the directories `GPSUSER42` and `GPSTEMP42` and all necessary subdirectories and links.

b) generate the `$U/WORK/PCFCTL.CPU` file for the BPE. You have to specify:

- the name of the host on which BPE jobs shall run. Make sure that this name may be used in a remote shell. (All entries done by the user (in the `$HOME/.rhosts`) resp. the settings that have to be done by the system administrator must be correct – they will be checked!).
- a nick name for this host used by the BPE to specify the CPU.
- the maximum number of jobs running at the same time on the CPU.

c) copy the menu panels of the *Bernese GPS Software* from the master directory `$X/PAN` into the user directory `$U/PAN`.

d) install the BPE DEMO campaign (optionally). If you specify "yes"

- the input options (`$X/OPT`$\longrightarrow$`$U/OPT`),
- the processing control files (`$X/PCF`$\longrightarrow$`$U/PCF`), and
- the script files for the BPE (`$X/USERSCPT`$\longrightarrow$`$U/SCRIPT`)

will be copied into your user directory. Moreover, the data for the test campaign will be copied into a campaign named `DOCU42_1` in the first project directory.

After this installation step you will find the following directory structure on your system:

a) Main/menu source code:

`$C/PGM`		:	(e.g., `/home/gpsauto/BERN42/PGM`)
	`/MAIN42`	:	Main programs
	`/MENU42`	:	Menu system programs
	`/BPE42`	:	BPE programs
	`/FOR`	:	Source code
	`/OBJ`	:	Object files
	`/EXE`	:	Executables

b) Fortran and C subroutines/functions:

`$C/LIB`		:	(e.g., `/home/gpsauto/BERN42/LIB`)
	`/ASTLIB42`	:	Fortran library with general astronomical constituents
	`/GPSLIB42`	:	Fortran library for GPS-Software subroutines
	`/MENLIB42`	:	Fortran menu system subroutines
	`/COMLIB42`	:	Fortran and C system dependent subroutines
	`/FOR`	:	Source code

	/OBJ	:	Object files
/INCLIB42	/FOR	:	Fortran and C include files resp. modules for Fortran 90 The include files have no extension but a leading "I:" in the filename to keep the include statements in the source code compatible to the DOS and VMS versions

c) Miscellaneous files:

$X	:	(e.g., /home/gpsauto/BERN42/GPS42)
/EXE	:	Bernese script files
/GEN	:	General data files like POLE, DATUM, etc.
/INX	:	Examples of option files for Bernese-Programs only running outside of the menu system (see also RUNGPS program description)
/PAN	:	All menu system panel files, keyboard tables, etc.
/SKL	:	Menu system skeleton files for creating main program option files
/DOC	:	Documentation
/BDS	:	BDS scripts (platform independent scripts)
/HLP	:	Menu help panels
/OPT	:	Option panels for the BPE example
/PCF	:	Process control files for the BPE
/USERSCPT	:	User scripts for the BPE
/SCRIPT	:	General script for the BPE

d) User area:

$U	:	(e.g., $HOME/GPSUSER42)
/INP	:	Input files for the main programs
/OPT	:	Data panel used by the BPE
/OUT	:	User-dependent output files
/PAN	:	User-dependent data input panels
/PCF	:	Process control files used by the BPE
/SCRIPT	:	Script files used by the BPE
/WORK	:	Work directory for the user (temporary files)
$T	:	(e.g. $HOME/GPSTEMP42) Temporary working area for BPE jobs

It is recommended to use this `install.sh` script for installing the software because it applies some changes in the source code according to the operating system and the compiler version.

If you run into trouble during the installation because of missing write access you have the possibility to redo part of this step again. First make sure you have executed `LOADGPS` and that you are in the `$INSTALL` directory.

- `sh instpgm` : install only source code of main and menu programs
- `sh instlib` : install only source code of all libraries
- `sh instmisc` : install miscellaneous files

You should now exit from the Bernese environment with the command "`exit`" and re-load the environment with the following command (be sure to use capital letters):

```
LOADGPS NEW
```

The parameter "NEW" passed to the script "LOADGPS" will make sure that the LOADGPS script sets (or re-sets) all the necessary links. This new execution of the script LOADGPS will also create all the user-specific directories (see variables $U and $T in the LOADGPS file) and it will copy the master files available in the subdirectories of $X to the corresponding user-specific directories:

```
$X/PAN        ⟶  $U/PAN
$X/OPT        ⟶  $U/OPT
$X/PCF        ⟶  $U/PCF
$X/USERSCPT   ⟶  $U/SCRIPT
```

After having created the user-specific directories once, it will not be necessary anymore to call the script LOADGPS with the parameter "NEW". It is even dangerous to do so if Bernese programs are running (e.g. scheduled by the BPE) during the execution of this command, because it resets some links.

25.3.4 Source Code Changes

The following changes in the source code may or may not be necessary. If they are, it is important to make the changes *before* compiling and linking the source code. Otherwise you have to recompile and link the entire software system in order to activate these changes.

25.3.4.1 Adjustment of the Size of Executables

The size of some main programs as, e.g., GPSEST or ADDNEQ heavily depend on the size of the declared arrays. All major arrays are declared using Fortran PARAMETER statements.

Depending on the available memory or the size of the networks to be processed the parameters may have to be adjusted. Three categories are proposed to the user:

SIZE_SMALL : intended for PC platforms, small networks

SIZE_MEDIUM : for workstations with medium resources, regional networks

SIZE_LARGE : for workstations with large resources, global solutions

The distribution is set to the "Large" memory model.

The parameters have to be set in the following files:

(1) General settings for several programs (using include files):

```
$C/LIB/INCLIB42/FOR/I:ADDNEQ
$C/LIB/INCLIB42/FOR/I:ADDINC
$C/LIB/INCLIB42/FOR/I:DISPLAY
$C/LIB/INCLIB42/FOR/I:MAXFLS
```

```
$C/LIB/INCLIB42/FOR/I:MAXGIM
$C/LIB/INCLIB42/FOR/I:MAXSAS
$C/LIB/INCLIB42/FOR/I:MAXSAT
$C/LIB/INCLIB42/FOR/I:MAXSTA
$C/LIB/INCLIB42/FOR/I:MAXSTC
$C/LIB/INCLIB42/FOR/I:SELECT
```

(2) Settings for special subroutines:

```
$C/LIB/GPSLIB42/FOR/ADDNOR.f
$C/LIB/GPSLIB42/FOR/DSPRES.f
$C/LIB/GPSLIB42/FOR/GTSCLK.f
$C/LIB/GPSLIB42/FOR/REDTRB.f
$C/LIB/MENLIB42/FOR/PRFSPT.f
$C/LIB/MENLIB42/FOR/STANEQ.f
```

(3) Settings for the main programs:

a) using include files

```
$C/LIB/INCLIB42/FOR/I:ADDINC
$C/LIB/INCLIB42/FOR/I:GPSEST
```

b) settings in the main program

```
$C/PGM/MAIN42/FOR/CODCHK.f
$C/PGM/MAIN42/FOR/COMPAR.f
$C/PGM/MAIN42/FOR/NEQFMT.f
$C/PGM/MAIN42/FOR/SNGDIF.f
$C/PGM/MAIN42/FOR/SNXNEQ.f
$C/PGM/MENU42/FOR/RXOBV3_P.f
$C/PGM/MENU42/FOR/SERVOBS.f
```

If you make some changes in one of these parameter settings after the installation procedure you have to distinguish three cases:

- Change in an include file (cases (1) and (3)a):

  You have to recompile the full source code using the command `COMPLINK`, because the include files are used by several subroutines and programs.

- Change in one of the subroutines (case (2)):

  It is only necessary to recompile the subroutine using either `CLGPSL` or `CLMENL` and after that to link all the main programs that are calling the subroutine, using the command `CLPGM`.

- Change in one of the programs (case (3)b):

  If the setting was changed in a main program it is sufficient to compile and link this program using the command `CLPGM`.

(For the use of the compiling scripts we refer to Section 25.3.5.)

25.3.4.2 Campaign List

The menu system uses a campaign list with the name defined in I:INCL_P:

```
DATA CMPLST/'X:/PAN/DAT11___.PAN'/
```

If you would like to have individual campaign lists for each user you would have to change the path into U:/PAN/ .

25.3.5 Compiling and Linking the Source Code

You are now ready to compile and link the complete Bernese source code using the command:

```
COMPLINK
```

Please make sure that the environment of the *Bernese GPS Software* is loaded using LOADGPS before you enter the compile command.

If you want to have a log file of the compilation you may use the following command (might be slightly different for different platforms):

```
COMPLINK > COMPLINK.LOG 2> COMPLINK.ERR
```

where the file COMPLINK.LOG will contain all normal system messages and compilation warnings and the file COMPLINK.ERR will contain compilation errors (hopefully this file will be empty).

Depending on the performance of your system you may now go for a coffee break. After the successful compilation of all programs you should have a working *Bernese GPS Software* System, Version 4.2.

You can start the *Bernese GPS Software* by entering G.

To facilitate the compiling and linking of parts of the software (e.g., if something went wrong when compiling with the command COMPLINK or if you changed the maximum dimensions in a program (see Section 25.3.4.1) you may use the following commands:

LIBCOMP AST : compile all routines in ASTLIB42 for which no object file exists. If no compilation error occurred, replace all object files in the archive. If you have to change one or more of the source code routines you can easily repeat this command. It will not compile a subroutine if an object file already exists.

LIBCOMP AST -a : recompile *all* routines in ASTLIB42. If no compilation error occurred, replace all object files in the archive. The option -a will delete all objects files of the specified library before the compilation. As first parameter you may use:

AST	:	for ASTLIB42
GPS	:	for GPSLIB42
MEN	:	for MENLIB42
COM	:	for COMLIB42
INC	:	for INCLIB42 (Fortran 90 only)

`PGMCOMP MAIN`	:	compile and link all main programs (in `MAIN42`) for which the executable does not exist.
`PGMCOMP MAIN -a`	:	recompiling *all* main programs. As first parameter you may use:

`MAIN`	:	for main programs
`MENU`	:	for menu system programs
`BPE`	:	for BPE programs.

`CLASTL` subname	:	Compile the specified subroutine of `ASTLIB42` and add or replace the object module in `$C/LIB/libBERN42.a`
`CLGPSL` subname	:	Compile the specified subroutine of `GPSLIB42` and add or replace the object module in `$C/LIB/libBERN42.a`
`CLMENL` subname	:	Compile the specified subroutine of `MENLIB42` and add or replace the object module in `$C/LIB/libBERN42.a`
`CLCOML` subname	:	Compile the specified subroutine of `COMLIB42` and add or replace the object module in `$C/LIB/libBERN42.a`
`CMAIN` pgmname	:	Compile and link the specified main program of `MAIN42`
`CMENU` pgmname	:	Compile and link the specified main program of `MENU42`
`CBPE` pgmname	:	Compile and link the specified main program of `BPE42`

If you have to compile the full source code you must start with the `INCLIB42` directory if you have installed the Fortran 90 version. After that all other subroutines `COMLIB42`, `ASTLIB42`, `GPSLIB42`, and `MENLIB42` have to be compiled. At the end the programs in `MAIN42`, `MENU42`, and `BPE42` must be compiled and linked.

If you run into trouble compiling the software because your compiler needs some special compiler options you have to adapt the entries in the compilation script for subroutines `$X/EXE/CMPLIB` resp. in the compile/link script for programs `$X/EXE/CLPGM`.

25.3.6 Hints and Tips

This section contains additional possibilities to adapt the software to your personal needs.

25.3.6.1 Use of JPL Ephemerides for Moon, Sun, and Planets

To improve the orbit model for the GPS satellites a new feature was implemented into the Version 4.2 of *Bernese GPS Software*: The JPL development ephemerides DE200 for the Moon, Sun, and Planets may be used instead of the subroutines SUN and MOON [*Standish*, 1990]. These ephemerides are not a component of the *Bernese GPS Software*. They should be downloaded from the JPL server:

`http://ssd.jpl.nasa.gov`

The "README" for the ephemerides package may be found under:

`http://ssd.jpl.nasa.gov/iau-comm4/README`

There are two versions available:

- a binary version for UNIX and
- an ASCII version for other operating systems.

In addition there is a program `asc2eph.f` for converting the ASCII files into the binary format. For

the use in the *Bernese GPS Software*, Version 4.2, the binary format is required!

Some UNIX systems (like Linux or IRIX) may have some trouble reading the binaries from JPL correctly. For those systems the conversion from ASCII to binary format is also required.

A documentation for the DE200 ephemeris and for other tools (like merging the files) is also given on the web-page mentioned above. Please read it carefully, because some modifications in the source code may be necessary. Some additional hints with respect to the use with the *Bernese GPS Software* are given on

ftp :	`ftp ubecx.unibe.ch`
login:	`anonymous`
password:	your full e-mail address
location:	`cd aiub`
	`cd BSWUSER`
	`cd TXT`
	`ascii`
	`get DE200.README`

25.3.6.2 Installation of Load Modules

If you want to separate the development environment from the production environment (or if you install the load modules on a second UNIX system) you have to copy all executables from the subdirectories `$C/PGM/MAIN42/EXE`, `$C/PGM/MENU42/EXE`, and `$C/PGM/BPE42/EXE` into the directory `$X/EXE` (on the second system).

In this case you have to:

- change the path to the programs in the data panels
  `$X/PAN/DAT021__.PAN`
  `$X/PAN/DAT022__.PAN`
  `$X/PAN/DAT023__.PAN`
  `$X/PAN/DAT024__.PAN`
  `$X/PAN/DAT025__.PAN`
  `$X/PAN/DAT026__.PAN`
  to `X:/EXE/` .
- change the path to the panel programs in the option file
  `$X/SKL/MENU.OPT`
  to `X:/EXE/` .
- change the path to the programs in the command files
  `$X/EXE/G`
  `$X/EXE/PRCDEF`
  `$X/EXE/RMENU`
  `$X/EXE/RUNGPS`
  to `X:/EXE/` .

25.3.6.3 Automatic Installation of the Environment for Additional Users

The data input panels, the input files for the “main” programs, files keeping the latest file selections and some other files are user- (or better: login-) specific. Therefore you have to create special

subdirectories for each individual user working with the *Bernese GPS Software*.

The user who started the `install.sh` script will be prompted for automatic execution of the `CRE_USR` script. In all other cases, you have to start this script manually:

`sh $X/EXE/CRE_USR` (replace $X with the full path because this variable is unknown outside of the environment of the *Bernese GPS Software*).

This script will

(1) make the directories `GPSUSER42` and `GPSTEMP42` and all necessary subdirectories and links.

(2) generate the `$U/WORK/PCFCTL.CPU` file for the BPE. You have to specify:

- the host name where BPE jobs shall run. Make sure that this name may be used with a remote shell (All entries done by the user (in the `$HOME/.rhosts`), resp. the settings done by the system administrator must be correct – it will be checked!).
- a nick name for this host used by the BPE to specify this CPU.
- the maximum number of jobs running at the same time on this CPU.

(3) copy the menu panels of the *Bernese GPS Software* from the master directory `$X/PAN` into the user directory `$U/PAN`.

(4) install the BPE DEMO campaign if you wish. For this case

- the input options (`$X/OPT`$\longrightarrow$`$U/OPT`),
- the processing control files (`$X/PCF`$\longrightarrow$`$U/PCF`), and
- the script files for the BPE (`$X/USERSCPT`$\longrightarrow$`$U/SCRIPT`)

will be copied into your user directory. Moreover the data for the test campaign will be copied into a campaign named `DOCU42_1` in the first project directory.

25.3.6.4 Manual Installation of the Environment for Additional Users

To create only the user-specific directories you just have to execute the script `LOADGPS` with the parameter "`NEW`"

```
LOADGPS NEW
```

The user environment will then be created automatically, with the exception of the example and the creation of the file `$U/WORK/PCFCTL.CPU`. It includes the creation of the directories

`$U/INP`	(Input files for the "main" programs)
`$U/OPT`	(Campaign specific data panel (used by BPE))
`$U/OUT`	(User-dependent output files)
`$U/PAN`	(Your data input panels)
`$U/PCF`	(Process Control Files (used by BPE))
`$U/SCRIPT`	(Script files (used by BPE))
`$U/WORK`	(Work directory for the user)

and a copy of all necessary files from the master directories in $X into the corresponding user directories in $U. At the end it corresponds to the steps (1) and (3) of the script $X/EXE/CRE_USR.

You should be careful when several users are running the *Bernese GPS Software* on the same system or one user runs the software several times simultaneously:

- If you have one campaign list only ($X/PAN/DAT11___.PAN) you have to set its protection in such a way, that all the users of the *Bernese GPS Software* in your institute can access and modify this file. If more than one user will edit this panel at the same time some entries may be lost.
- The path to each campaign directory is defined by the user (e.g., P:/). You have to make sure that the protection of the parent directory allows the user to create the campaign subdirectories. The protection has to allow "write access" to the newly created files by other users if others have to access the same data, too. (However, working *simultaneously* on the same campaign by different users may cause unpredictable effects).
- Problems may occur if one user runs the same program several times or if one user runs the menu system more than once. Some of the temporary files may conflict, and the programs will crash!

25.3.6.5 Setting up the BPE

The BPE is capable of using different CPUs and different machines for what we call parallel processing. For this purpose it uses the remote shell command ("rsh" or "remsh" for HPs). This will be checked in the CRE_USR script.

If you had a problem in the CRE_USR script of the type

```
WARNING: rsh test command failed. The error was:
Permission denied.
rsh: connection failed

Possible failures are:
    Permission denied.       Check .rhosts file on eomer1
    Unknown host.            Make sure eomer1 is a valid host name
```

you should check all settings for the remote shell:

To be able to use the remote shell command the machines you plan to access using this command should be entered either in the system file /etc/hosts.equiv or in the user file $HOME/.rhosts. Because the first option requires system access privileges we advise you to use the "$HOME/.rhosts" file. If your system names are, e.g., "eomer1" and "eomer2 and your login on both machines is "gandalf", then the two entries in the .rhosts file will look like this:

```
eomer1 gandalf
eomer2 gandalf
```

Both systems should have access to the campaign directory (disk) and to the same temporary environment (`$T`). On some systems the domain name has to be added, e.g., `eomer1.unibe.ch`.

We also have to tell the BPE which CPUs (machines) it is allowed to use. A file `$U/WORK/PCFCTL.CPU` should be created by the `CRE_USR` script. This file will look as follows:

```
# Process control CPU information
CPU      TRUE_NAME                      SPEED    NCPU SF   IDLE MAXJ JOBS
8******* 30**************************** 8******* 4*** 4*** 4*** 4*** 4***
CPU1     eomer1                         SLOW        1  300  100    2    0
CPU2     eomer2                         FAST        1  300  100    2    0
```

Basically you only have to change the "`TRUE_NAME`" field.

25.3.7 Processing Examples

A test campaign `DOCU42_1` is distributed together with the software. Please use it to test the BPE and the software at the same time.

This example is also available on our anonymous ftp. Use the following commands to download this example:

ftp :	`ftp ubecx.unibe.ch`
login:	`anonymous`
password:	your full e-mail address
location:	`cd aiub`
	`cd BSWUSER`
	`cd EXAMPLES`

You will find a file named `readme.txt` with further instructions.

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