```
    Outliers will be marked with a flag by the program. With this option
    you specify whether these markings should be written to the observation
    file(s).
    YES:
      The outliers found will be marked and the markings will be saved in
      the observation file(s). These marked observations will therefore not
      be used by follow-up programs.
    NO:
      Marking are not saved. The observation files will contain exactly the
      information before and after this program run. Possible outliers will
      still be used by follow-up programs.
    RECOMMENDED VALUE: YES

Polynomial Screening:

  PRINT EXTENDED INFO:
    Two printing levels may be selected. With "YES" all the details on the
    marking of outliers will be printed. With "NO" only a summary of the
    number of observations marked will be available in the output file.
    RECOMMENDED VALUE: NO

  POLYNOMIAL DEGREE:
    The polynomial degree for the approximation of the observations should
    be small, usually not larger than 1 or 2. The outlier detection algo-
    rithm will check, whether the a few consecutive observations may be
    represented by a low degree polynomial on the level of the observation
    noise (see RMS OF CODE OBS. below).
    RECOMMENDED VALUE: 2

  MAX. FIT INTERVAL:
    This value defines the maximum time interval that may be represented
    by a polynomial of the degree specified in the previous field. The
    interval to be covered by a polynomial of degree n has to contain at
    least n+2 points (observation epochs). E.g. with a sampling rate of 30
    sec and a polynomial degree of 2 the maximum time interval has to be at
    least 2 minutes. The interval should also not be much larger than the
    number of epochs needed for the fit. The program CODCHK will automati-
    cally change the maximum time interval if it is too small for a given
    sampling rate.
    RECOMMENDED VALUE: 3 Minutes

Rms of Code Observation:

  RMS OF CODE OBS.:
    The rms of the code observations to be entered in this field defines
    the level at which observations will be marked and rejected. Depending
    on the quality of the receiver (quality of the code observations) and
    whether SA or AS is turned on, the rms should be set to between a few
    meters and about 20 meters. If many observations are rejected that are
    just above the 3-sigma limit (use the option "PRINT EXTENDED INFO" to
    get these details in the output), the rms value should be increased.
    RECOMMENDED VALUE: 20 meters
                                                                         MR
```

```
 4.2                      PROCESSING: CODE PROCESSING

   CAMPAIGN        >          <

 Job Identification:
   JOB CHARACTER       >   <        (blank or character from A - Z, 0 - 9)

 Input Files:
   CODE            >          <     COORDINATES      >          <
   BROADCAST       > NO       <     STANDARD ORBIT   >          <
   ECCENTRICITIES  > NO       <     SATELLITE CLOCKS >          <

 Output Files:
   COORDINATES     > NO       <     RESIDUALS        > NO       <
   PHASE           >          <     RESULT SUMMARY   > NO       <
```

```
4.2 | PROCESSING: CODE PROCESSING | HELP

General Remarks:

  With this and the following panels you select the processing options for
  the program CODSPP. The main purpose of this program is the estimation
  of receiver clock corrections with respect to GPS time and the determi-
  nation of approximate station coordinates using code zero-diff. measure-
  ments.

Job Identification:

  JOB CHARACTER:
    If you would like to run more than one CODSPP program at the same
    time on a multitask system, you have to use different job identifica-
    tion characters to obtain unique input option files for the program
    CODSPP. A through Z, 0 through 9. and blank are valid characters.
    If the field is not blank it will automatically be changed to the
    next character in alphabetic order for the next run.
    RECOMMENDED VALUE: blank

Input Files:

  CODE:
    Selection of zero-difference code files to be processed. Several files
    may be processed in the same program run.

  COORDINATES:
    Selection of an a priori coordinate file. This coordinate file must
    contain all the sites you are processing.

  BROADCAST:
    Selection of a broadcast orbit file (Bernese format). Only one file
    may be selected. Therefore only code observations covered by the
    broadcast messages in this file may be processed.
    If a broadcast file is specified, neither a standard orbit file nor
    a satellite clock file should be selected. The satellite clock infor-
    mation already given in the broadcast file.

  STANDARD ORBIT:
    Instead of a broadcast file a standard orbit file may be selected.
    In this case a satellite clock file name has to be given, too.

  ECCENTRICITIES:
    Optionally, a site coordinate eccentricity file may be specified con-
    taining local ties between markers.

  SATELLITE CLOCKS:
    If the satellite positions are obtained from a standard orbit file, a
    satellite clock file has to be specified containing the satellite
    clock information. Use menu 3.8 to create such a file from broadcast
    messages or extract clock information when generating tabular orbits
    from precise orbit files (menu 3.2).

Output Files:

  COORDINATES:
    To save the coordinates estimated using code observations (single
    point positioning) enter a coordinate file name. If "NO" is specified,
    coordinates are not saved.

  RESIDUALS:
    The residuals of the single point positioning solutions are saved, if
    you enter a filename, here. These residuals may be looked at using
    menu 5.3.1 or 5.3.2 . Residuals may also be written to the program
    output file by setting the corresponding option in panel 4.2.2.

  PHASE:
    In normal operation the most important results of this program are
    the receiver clock corrections with respect to GPS time. These recei-
    ver clock corrections have to be saved in the phase zero-difference
    observation file for later use !  If you specify "blank" here, the
    clock corrections will be written into the phase observation file
    corresponding to the selected code observation file. With "NO" recei-
    ver clock corrections will NOT be saved in the phase zero-difference
    observation files.
```

```
    RECOMMENDED VALUE: blank

  RESULT SUMMARY:
    The resulting site coordinates may be saved in two special summary
    files (one with extension .SMC and one with extension .SME). In the
    first file a line containing the estimated geocentric coordinates
    (x,y,z), their formal errors, and the most important processing
    options are appended for each input observation file processed in
    this program run.
    In the second file the ellipsoidal coordinates and rms errors are
    saved. If such a summary file does not yet exist, it will be created.
                                                                        MR
```

```
 4.2-1                      CODE PROCESSING: INPUT 1

   TITLE    >                                                      <

   Parameters:
     FREQUENCY              > L3   <    (L1, L2 or L3)
     CLOCK POLY.DEGREE      > E    <    (max. 7, E for one offset per epoch)
     ESTIMATE COORDINATES   > YES  <    (YES or NO)

   Atmosphere Models:
     TROPOSPHERE            > SAAS <    (NO,SAAStamoinen or HOPField)
     IONOSPHERE             > NO   <    (YES or NO)

   Observation Selection:
     MIN. ELEVATION         > 10   <    degrees
     SAMPLING RATE N        > 1    <    (only every n-th observation used)
     OBSERV. WINDOW         > NO   <    (YES.., NO or ASIS)
```

```
 4.2-1                  CODE PROCESSING: INPUT 1                 HELP

  TITLE:
    This title line will be printed as header comment in the program output
    and will be saved in all the result files specified in panel 4.2 to
    document the program run. The title should characterize the program run
    by e.g. giving the most important options used and the session.

  Parameters:

    FREQUENCY:
      The code observations of the L1 or L2 frequency or the ionosphere-free
      linear combination (L3) may be processed. When L3 is selected, the
      program will automatically switch to L1, if no or only few L2 observa-
      tions are available. Whenever possible L3 should be used to eliminate
      the ionospheric refraction.
      RECOMMENDED VALUE: L3

    CLOCK POLY.DEGREE:
      With this option you specify the polynomial degree of the receiver
      clock corrections you are estimating. The entire time interval of a
      code observation file will be represented by a polynomial of the
      specified degree. The maximum degree is 7. If you enter the option
      "E", a receiver clock offset will be determined for each observation
      epoch. Some receivers produce 1 msec jumps and may therefore only be
      processed using the option "E". You should use polynomials only, if
      the receiver was driven by an excellent external oscillator (e.g. a
      hydrogen maser).
      RECOMMENDED VALUE: E

    ESTIMATE COORDINATES:
      This flag indicates whether station coordinates should be estimated or
      not. If "NO" is entered here, the a priori coordinates will be used
      as "true" values for the receiver clock estimation. If the program
      gives very large residuals and you know to have good a priori coordi-
      nates available it might help to fix the coordinates (option "NO") in
      order to identify problem (e.g. a bad satellite).
```

```
    RECOMMENDED VALUE: YES

Atmosphere Models:

  TROPOSPHERE:
    There are three possibilities to model the tropospheric delay.
    NO:
      No tropospheric correction is applied. This option should only be
      used for test purposes (e.g. to demonstrate the biases resulting
      when troposphere delays are neglected).
    SAAS:
      Troposphere model by Saastamoinen. Pressure, temperature, and re-
      lative humidity (extrapolated from sea level values given in the
      constant file specified in {DAT031__}) are used to compute the sum
      of the wet and dry delays.
    HOPF:
      Hopfield model for tropospheric refraction. Pressure, temperature,
      and humidity are generated as above.
    There is no possibility to use measured surface meteorological data.
    RECOMMENDED VALUE: SAAS

  IONOSPHERE:
    When processing L3 you obviously do not need to specify an ionosphere
    model. If you specify "YES" a very simple ionosphere model will be
    applied. This model has "hardwired" values for the day- and night-time
    mean electron content in the atmosphere and is therefore not really
    representative for the actual ionospheric conditions.
    RECOMMENDED VALUE: NO

Observation Selection:

  MIN. ELEVATION:
    Only code observations above the elevation cut-off angle specified
    here will be used. The residuals for observations below the cut-off
    angle will be printed (if residual printing is activated, see next
    panel) with a flag "E" indicating that such observations were not
    used for the estimation itself.
    RECOMMENDED VALUE: 10 degrees

  SAMPLING RATE N:
    Under special circumstances you may wish to only process every n-th
    code observation epoch. If you enter e.g. 5 in this field, only
    every fifth observation epoch will be processed. If you use the
    epoch-wise receiver clock estimation (option "E" described above) you
    should always process all observations, because epochs without a
    receiver clock correction estimated will produce problems in the
    phase processing to follow this step.
    RECOMMENDED VALUE: 1

  OBSERV. WINDOW:
    NO:
      All the observations in the code files will be processed.
    YES:
      A special panel 4.2-1.1 will be displayed allowing to enter a time
      window to be processed. Warning: clock corrections will only be
      available for the specified window.
    ASIS:
      The time interval you specified last time (still present in the
      time window panel 4.2-1.1) will automatically be used without dis-
      playing the panel. If you are not sure what window you entered
      last time you used this option you better use the option "YES" to
      see and check the window setting.
    RECOMMENDED VALUE: NO
                                                                     MR
```

```
4.2-1.1 | CODE PROCESSING: OBS. WINDOW

                START DATE                  END DATE

            yy mm dd    hh mm ss       yy mm dd    hh mm ss

          >         < >         <   >         < >         <
```

```
4.2-1.1   CODE PROCESSING: OBS. WINDOW                                HELP

 START TIME, END TIME:
   This input panel is used to specify an observation window to be pro-
   cessed. The window will be the same for all the code files of one pro-
   gram run. Window start and end time is given as year, month, day, hour,
   minute, and second.
   EXAMPLE:
            yy mm dd     hh mm ss       yy mm dd     hh mm ss

          > 96 11 04 < > 00 00 00 <   > 96 11 04 < > 02 00 00 <
                                                                         MR
```

```
4.2-2     CODE PROCESSING: INPUT 2

  Print Options:
    RESIDUALS                > NO   <     (YES or NO)
    ELEVATIONS               > NO   <     (YES or NO)

  Iterations:
    MAX. NUMBER OF ITERAT.   > 10 <       (greater than 0)

  Outlier Detection:
    OUTLIER DETECTION        > YES  <     (YES or NO)
    MAX. RESIDUAL ALLOWED    > 100.0   <  meters
    CONFIDENCE INTERVALL     > 5.0     <  (in units of one sigma)
```

```
4.2-2     CODE PROCESSING: INPUT 2                                    HELP

 Print Options:

   RESIDUALS:
     The residuals of the single point positioning are printed into the
     program output together with a flag indicating the status of the
     observation (marked, no orbits, ...), if you say "YES" here.
     If you would like to save the residuals in a special residual
     file, you should specify a residual output file in panel 4.2 .
     RECOMMENDED VALUE: NO

   ELEVATIONS:
     If "YES" is specified here the satellite elevation angles are
     included in the program output.
     RECOMMENDED VALUE: NO

 Iterations:

   MAX. NUMBER OF ITERAT.:
     Coordinates and receiver clock errors are estimated iteratively. This
     is necessary in particular if the a priori coordinates are of bad
     quality. With this option you may set the number of iterations to 1
     if you already have very good coordinates to speed up the processing.
     The clock corrections are then computed from the observed-computed
     (o-c) values and the residuals will be set to the o-c values, too.
     The iterative process is stopped, if the coordinate changes are below
     half a meter even if the maximum number of iterations is not yet
     reached. The actual number of iterations performed is given in the
     output file.
     RECOMMENDED VALUE: 10

 Outlier Detection:
```

```
  OUTLIER DETECTION:
    This option turns on ("YES") or off ("NO") the outlier detection al-
    gorithm. An observations will be considered an outlier and not be
    used in the parameter estimation, if the "observed-computed" value
    ("o-c") differs by more than the maximum allowed residual size
    (given in the next field) from the mean "o-c" value of all
    satellites of this epoch and also by more than n times the rms of
    the "o-c" values of one epoch, where the value for n is entered in the
    field "CONFIDENCE INTERVAL". If only a few satellites (e.g. 2 or 3)
    are available most of the time or if the a priori coordinates are very
    bad, the outlier detection might not work in a reliable way.
    Outliers are NOT marked in the code or phase zero-difference obser-
    vation files.
    If you select "NO" here, the next two options are of no importance.
    RECOMMENDED VALUE: YES

  MAX. RESIDUAL ALLOWED:
    This option defines the maximum absolute value for a residual (more
    precisely the "o-c" level, see above). Observations above this level
    will not be used. If SA is turned off, this outlier detection level
    might be set to a lower value (e.g. 30 meters).
    RECOMMENDED VALUE: 100.0 meters

  CONFIDENCE INTERVAL:
    This option makes sure, that observations are not eliminated because
    of satellite clock, site coordinate, and orbit errors (see option
    "OUTLIER DETECTION" above).
    RECOMMENDED VALUE: 5.0
                                                                       MR
```

```
4.3  |                 PROCESSING: FORM SINGLE DIFF.

  CAMPAIGN                > <  (blank for selection list)

  STRATEGY                > OBS-MAX   < (MANUAL    (M), SHORTEST (S),
                                         AUTO-STAR (A), OBS-MAX (O), PLUS)
Input Files:
  MEASUREMENT TYPE        > PHASE   <  (Any  : CODE or PHASE)
  ZERO DIFF. FILE 1       >         <  (Any  : blank for selection list)
  ZERO DIFF. FILE 2       >         <  (M    : blank for selection list)
  COORDINATES             >         <  (S+A+P: blank for selection list)
  ECCENTRICITIES          > NO      <  (S+A+P: NO, blank for sel. list)
  PRE-DEFINED BASELINES   > NO      <  (S+O+P: NO, blank for sel. list)
  CLUSTER DEFINITION      > NO      <  (NO, blank for selection list)
Output File:
  SINGLE DIFFERENCE       >         <  (Any: blank for default file name,
                                            HEADER: Header files only)
  BASELINE DEFINITIONS    > NO      <  (NO, if not to be saved)
  CLUSTER DEFINITION      >       <    (enter only if cluster input given)
```

```
4.3  |             PROCESSING: FORM SINGLE DIFF.              |  HELP

General Remarks:
  This program is used to create single difference files (baselines) from
  zero-difference phase or code observation files. Make sure that you run
  the program CODSPP and saved the receiver clock corrections in the zero-
  difference observation files before forming single difference files.

  STRATEGY:
    In this field you have to specify the strategy used for building the
    single difference files. If you specify MANUAL here you will have to
    select manually between which stations (zero difference files) the ba-
    selines (single difference files) will be created. SHORTEST means that
    the (independent) set of the shortest baselines will be created. AUTO-
    STAR strategy connects one central station with all remaining sta-
    tions minimizing the sum of all baseline lengths.
    OBS-MAX strategy optimizes the single differences according to the
    number of observations common for both stations. The PLUS strategy is
    used if a backbone of pre-defined baselines should be formed in
```

```
    addition to the linearly independent set of baselines.
    RECOMMENDED VALUE: OBS-MAX

Input Files:

  MEASUREMENT TYPE:
    Either phase or code single difference files may be created. Usually
    there is no reason to use code observations in processing steps to
    follow (the exception may be the Melbourne-Wuebbena ambiguity resolu-
    tion strategy). If you would like to form the same baselines for the
    code observations as you did for the phase observations, you have to
    save the baseline definitions in a baseline definition file (see
    below) when you form the phase single difference files and then intro-
    duce this information as "pre-defined baselines" (see below).
    RECOMMENDED VALUE: PHASE

  ZERO DIFF. FILE 1:
    Here the zero difference files have to be specified. If MANUAL strate-
    gy is used (see above) only the first zero difference files are speci-
    fied.

  ZERO DIFF. FILE 2:
    This field is used for MANUAL strategy only (see above). You have to
    specified the second zero difference files or leave the field blank
    to get a selection list. You will get a selection list for each first
    zero difference file you selected.

  COORDINATES:
    The a priori coordinates of the stations have to be specified. This is
    not necessary if the MANUAL strategy is used.

  ECCENTRICITIES:
    The eccentricities have to be specified if there are some eccenter
    stations and you do not use the MANUAL strategy.

  PRE-DEFINED BASELINES:
    Using some strategies (SHORTEST, OBS-MAX, PLUS) you might want to
    force the program to generate some specific baselines. Such "pre-
    defined baselines may be specified in a special file (see menu 1.5.2
    for the creation of a file containing baseline definitions and
    {X:\INX\EXAMPLE.BSL for an example).

  CLUSTER DEFINITION:
    It is possible to defined so-called clusters of stations by assigning
    a cluster number to each station you are processing. These definitions
    have to be given in a so-called cluster definition file (see
    {X:\INX\EXAMPLE.CLU}). This cluster definition file will then be used
    to divide the baselines actually created by the program SNGDIF into
    clusters of baselines depending on the cluster number of the first
    station of a baseline. The files containing the names of the single-
    difference files belonging to each cluster (see option CLUSTER
    DEFINITION below) may then be used to process (e.g. with the BPE)
    each cluster with GPSEST using correct correlations.

Output File:

  SINGLE DIFFERENCE:
    The names of the single difference files will be created automatically
    using the abbreviation table (menu 1.4.3) if you specify blank here.
    Otherwise you have to specify the output file name. By specifying
    HEADER you have the possibility to create the header files only (but
    not the observations files).
    RECOMMENDED VALUE: blank

  BASELINE DEFINITIONS:
    It is possible to save the definitions of the created baselines in a
    file. This file may be used as input (see option PRE-DEFINED
    BASELINES) if you want to create exactly the same set of baselines
    e.g. for the next session etc.

  CLUSTER DEFINITION:
    If you specified a cluster definition file above (see option CLUSTER
    DEFINITION) you should specify a filename here. In this case a list of
    the single difference files belonging into one cluster (according to
    the definitions given in the input cluster file) will be generated for
    each cluster. If N clusters are present, N such file lists will be
    generated with the generic names xxxxxx01, xxxxxx02, etc, where
```

```
    xxxxxx is the cluster output file name given in this field. Redundant
    baselines, if present, will be listed in the file xxxxxx00.
    An example of such a cluster file (containing the names of the single-
    difference files belonging to a cluster): {X:\INX\EXAMPLE.CLB}.
                                                                        LM
```

```
4.3-1                    FORM SINGLE DIFFERENCES: INPUT

Simultaneous Observations:
  MAXIMUM TIME INTERVAL          > 1.50  <     SEC

Set new Ambiguity:
  AFTER A BREAK OF               > 20    <     MIN
  WHEN CYCLE SLIP FLAG SET        > NO  <      (YES or NO)

Optimize Baselines (Option 0 only):
  MAXIMUM BASELINE LENGTH        > 9000  <     KM  (Option 0 only)
  MINIMUM NUMBER OF OBSERVATIONS > 600   <     Scaled in 1 obs/min/freq

Observation Filename Format
  LENGTH OF SESSION NUMBER        > 4 <        (4 or 3 characters)
```

```
4.3-1                FORM SINGLE DIFFERENCES: INPUT                  HELP

Simultaneous Observations:

  MAXIMUM TIME INTERVAL:
    This option is important if you combine two different receivers types
    and the measurement epochs do not coincide (note: under SA conditions
    it is mandatory to use simultaneous observations). This option
    tells the program in which cases the two measurement epochs may be
    identify as "simultaneous". If you have 1 second data you should
    specify a value smaller than 1 second (e.g. 0.5 sec).
    RECOMMENDED VALUE: 1.50 second

Set new Ambiguity:

  AFTER A BREAK OF:
    It is possible to set up a new ambiguity parameter after a break in
    the observations. Here you specify the length of the break. This
    option is usually not very important because the same option exists
    in program MAUPRP (menu 4.4.2, {DAT4424_ AFTER A GAP LARGER THAN}).
    RECOMMENDED VALUE: 20 minutes

  WHEN CYCLE SLIP FLAG SET:
    Usually it is not necessary to set up a new ambiguity parameter if a
    cycle slip flag is found in the observation file. Program MAUPRP
    (menu 4.4.2) is able to repair most of the cycle slips.
    RECOMMENDED VALUE: NO

Optimize Baselines (Option 0 only):

  MAXIMUM BASELINE LENGTH:
    If you selected the OBS-MAX strategy in panel {DAT43___} it is
    possible to define the maximum length of the baselines allowed to be
    formed. No baseline longer than this value will be created no matter
    how many observations this baseline would contain.
    RECOMMENDED VALUE: 9000 km

  MINIMUM NUMBER OF OBSERVATIONS:
    Together with the OBS-MAX strategy (see {DAT43___}) it is possible to
    define the minimum number of observations. Baseline which contain
    less than the specified number of observations (scaled to a sampling
    rate of one minute and to one frequency) will not be create.
    RECOMMENDED VALUE: 600

Observation Filename Format
```

```
   LENGTH OF SESSION NUMBER:
     It is possible to define sessions using either 3 or 4 characters (see
     menu 1.3). If you use 4-character session identifiers in the session
     table you have to specify 4 here, otherwise 3.
     RECOMMENDED VALUE: 4
                                                                        LM
```

```
 4.4.1   |                  PROCESSING: PHASE CHECK

   CAMPAIGN          >          <    (blank for selection list)

 Input Files:
   SINGLE DIFF.      >          <    (blank for selection list)
   STANDARD ORBIT    >          <    (blank for selection list)
   COORDINATES       >          <    (blank for selection list)
   ECCENTRICITIES    > NO       <    (NO, if not used; blank for sel.list)
   SATELL. CLOCKS    > NO       <    (NO, if not used; blank for sel.list)
```

```
 4.4.1   |                PROCESSING: PHASE CHECK                 |  HELP

General Remarks:
  This program OBSTS1 is the old phase pre-processing program. Nowadays you
  should use the program MAUPRP (see {DAT442__}) for the phase pre-process-
  ing and not OBSTS1. A possible exception might be if you are interes-
  ted to look at the single difference residuals or at a screening on
  the single difference level.

 Input Files:

   SINGLE DIFF.:
     Selection of a single-difference phase file to be processed. Only one
     file may be processed in one program run.

   STANDARD ORBIT:
     Exactly one standard orbit file containing the information about the
     satellite positions has to be selected.

   COORDINATES:
     Selection of an a priori coordinate file. This coordinate file must
     contain all the sites you are processing. The a priori coordinates
     should have a quality of about 1 meter.

   ECCENTRICITIES:
     Optionally a site coordinate eccentricity file may be specified con-
     taining local ties between markers (example: {X:\INX\EXAMPLE.ECC}).

   SATELL. CLOCKS:
     The program may use a satellite clock file containing the informa-
     tion about the satellite clocks. The satellite clock error is elimi-
     nated when forming single differences, if both receivers take the
     measurements simultaneously (within 1 msec). Therefore it is usually
     not necessary to use a satellite clock file.
     RECOMMENDED VALUE: NO
                                                                         MR
```

```
 4.4.1-1 |            SINGLE DIFFERENCE PREPROCESSING: INPUT

    Option:               >    <    (E:End, Q:Quit, X:exit, blank:continue)

    General Parameters:
      WAVELENGTH          > L1 <    (L1,L2,L5 or L3)
      SEARCH FOR        > CYCLES <  (CYCLES or HALF)
```

```
Single Diff. Preproc.:
  PROCESSING          > NO   <   (YES or NO)
  PRINTING            > YES  <   (YES or NO)
  POLYNOM. DEGREE     > 2    <   (max. 6)
  TOLERANCE           > 1000 <   CYCLES

Double Diff. Preproc.:
  PRINTING           > LARGE <   (NO,ALL or LARGE)
  POLYNOM. DEGREE      > 0 <     (max. 6, 0: triple diff. solution)
```

4.4.1-1	SINGLE DIFFERENCE PREPROCESSING: INPUT	HELP

```
Option:
  Usually you start the cleaning of the data by processing first the
  L1 frequency, then L2, and then -- for longer baselines, where the
  ionosphere comes into play -- also L5 and L3, in this order.
  blank:
    Leave the field blank to process the single difference file with
    the options set below. After the processing the program will return
    to this panel here.
  E:
    This value will end the pre-processing of the current file and will
    bring you back into the single difference file selection list.
    Before leaving the pre-processing you will be prompted whether you
    want to save the cleaned file or not.
  Q:
    Quit the pre-processing. The cleaned single-difference file will
    NOT be saved. You return to the single-difference file selection
    list.
  X:
    Complete exit from the pre-processing program OBSTS1. You return to
    the menu panel 4.4 .

General Parameters:

  WAVELENGTH:
    Specify the linear combination of the L1 and L2 single-difference
    observations you would like to clean. Apart from the original
    carriers you may also look at and correct the widelane (L5) and the
    narrow lane (L3). L5 has the advantage that the wavelength of about
    86 cm is much longer than the L1 wavelength. When cleaning L5 you
    will only remove cycle slips with a different slip size (in cycles)
    in L1 and L2. When using L3 -- this you should do after having
    cleaned L5 first -- the ionospheric biases are eliminated. The
    wavelength is then about 10 cm (narrow lane, assuming that L5 is
    clean).

  SEARCH FOR:
    This option allows you to decide whether you search for full cycles
    or half cycles (e.g. for squaring type receivers in L2).

Single Diff. Preproc.:

  PROCESSING:
    As a very first step the phase observations should be processed
    on the single-difference level to remove the largest cycle slips
    already on this level. After having processed the single-difference
    observations once on each frequency you may turn off this step by
    setting this option to "NO". In this step a polynomial is fit
    through the O-C (observed-computed) values computed using the a
    priori coordinate and orbit information. Residuals larger than a
    user-specified level (see below) are said to be cycle slips and
    are corrected.

  PRINTING:
    YES:
      The differences between consecutive single-difference residuals
      of the polynomial fit (see next option) are listed on the screen.
    NO:
      Residuals of the single-difference cleaning step are not
      displayed.
```

```
      POLYNOM. DEGREE:
        Polynomial degree for the fit through the O-C values. You should
        not use a degree higher than 6 because you might run into numerical
        problems. With a polynomial degree of zero you can study the be-
        haviour of the receiver clock. Depending on the quality of the
        receiver clock you may have to use a higher or lower polynomial
        degree (a higher degree is necessary for a bad clock). If you see
        large systematic effects (not cycle slips, but residuals e.g.
        larger than 1000 cycles) when looking at the residual (see previous
        input field) you may have to increase the polynomial degree.

      TOLERANCE:
        In this field to enter the tolerance level for the correction of
        cycle slips on the single-difference level. If you specify 1000
        cycles here, all the observations showing residuals larger than
        1000 cycles will be corrected.
        RECOMMENDED VALUE: 1000 cycles

    Double Diff. Preproc.:

      PRINTING:
        Various printing levels are possible for the double-difference
        screening:
        NO:
          No triple-difference residuals are listed for the double-
          difference screening.
        ALL:
          All triple-difference residuals are listed. Residuals larger than
          3 times the rms of the fit are marked with a star.
        LARGE:
          Only the large residuals (those that are larger than 3 times the
          rms of the polynomial fit) are listed.

      POLYNOM. DEGREE:
        In this input field you define the polynomial degree to be used to
        fit the double-difference observations. Usually a low degree poly-
        nomial should work fine (e.g. 1 or 2). When setting the polynomial
        degree to zero the residuals of a triple-difference solution are
        screened.
        RECOMMENDED VALUE: 0
                                                                          MR
```

```
4.4.2            PROCESSING: LATEST MANUAL/AUTOMATIC PREPROCESSING

   CAMPAIGN          >          <    (blank for selection list)

  Input Files:
    SINGLE DIFF.     >          <    (blank for selection list)
    COORDINATES      >          <    (blank for selection list)
    STANDARD ORBIT   >          <    (blank for selection list)
    IONOSP. MODELS   > NO       <    (NO, if not used; blank for sel.list)
    ECCENTRICITIES   > NO       <    (NO, if not used; blank for sel.list)
    SATELL. CLOCKS   > NO       <    (NO, if not used; blank for sel.list)

  Output File:
    COORDINATES      > NO       <    (NO, if not to be saved)
    RESIDUALS        > NO       <    (NO, if not to be saved)
```

```
4.4.2        PROCESSING: LATEST MANUAL/AUTOMATIC PREPROCESSING        HELP

  General Remarks:

    With this and the following panels you select the processing options for
    the program MAUPRP. The main purpose of this program is the preprocess-
    ing of the single-diff. phase measurements. The program scans the measu-
    rements looking for cycle slips. If a cycle slip is found the program
    tries to correct the measurements. If the size of the cycle slip could
    not be reliably determined the program will remove the data point as
```

```
    an outlier or introduce a new ambiguity parameter.

  Input Files:

    SINGLE DIFF:
      Selection of the single-difference phase files to be processed.
      Several files may be processed in the same program run.

    COORDINATES:
      Selection of an a priori coordinate file. This coordinate file must
      contain all the sites you are processing. The a priori coordinates
      should be accurate to about 1 meter or better, else a set of coordi-
      should be estimated (a triple difference solution) and saved in an
      coordinate output file (see below) before the actual data editing.
      For this special MAUPRP run (triple difference solution only) you may
      set the option "SAVE SCREENED FILES" to "NO" in the next panel
      (see {DAT4421_}) to leave the single difference files untouched.

    STANDARD ORBIT:
      Exactly one standard orbit file containing the information on the
      satellite positions has to be selected.

    IONOSP. MODELS:
      The program may use ionosphere models produced by program IONEST
      (menu 4.7) or by the program GPSEST (menu 4.5). Usually it is not help
      much to apply an ionosphere model correction.
      RECOMMENDED VALUE: NO

    ECCENTRICITIES:
      Optionally a site coordinate eccentricity file may be specified con-
      taining local ties between markers.

    SATELL. CLOCKS:
      The program may use a satellite clock file containing the satellite
      clock information. The satellite clock errors are eliminated when
      forming single differences, if both receivers take the measurements
      simultaneously (within 1 msec). Therefore it is usually not necessary
      to use a satellite clock file.
      RECOMMENDED VALUE: NO

  Output File:

    COORDINATES:
      To save the coordinates estimated with a triple difference phase
      solution you have to specify a coordinate file name here. The results
      of the triple difference solution may provide good a priori
      coordinates for the program GPSEST (menu 4.5). The result of a triple
      difference solution are the coordinates of the second station of the
      baseline relative to the first station. If all single-difference
      files of a session are pre-processed together, the program will
      generate a consistent set of coordinates for all sites relative to the
      fixed site (to be specified in {DAT4421_ FIXED STATION}). If not all
      baselines are connected, the program may have to selected one or more
      additional fixed sites. They will get the flag "F" in the resulting
      coordinate file (all other estimated sites will be flagged with "T"
      for "Triple-difference").
      If "NO" is specified coordinates are not saved.

    RESIDUALS:
      The residuals of the triple difference solution are saved, if you
      enter a filename here. These residuals may be looked at using menu
      5.3.1. If the program MAUPRP works in MANUAL mode {DAT4421_ MANUAL},
      it is possible to look at the residuals interactively during the
      program run.
                                                                       LM
```

```
4.4.2-1                    NEW PREPROCESSING: INPUT 1

  General Parameters:
    PROCESSING MODE          > AUTOMATIC <     (MANUAL, AUTOMATIC)
    FREQUENCY TO CHECK       > COMBINED  <     (L1,L2,BOTH or COMBINED)
    SAVE SCREENED FILES         > YES <        (YES or NO)
    ADJUST FREQ./WLFAC.         > YES <        (YES or NO)
```

```
 Change Other Options:
   CHANGE OPTIONS            > YES <        (YES.. or NO)

 Saving Coordinates:
   FIXED STATION       > AUTO            <  (AUTO for automatic selection)
```

```
4.4.2-1                 NEW PREPROCESSING: INPUT 1                      HELP

 General Parameters:

   PROCESSING MODE:
     The program may work either in automatic or in manual mode. In manual
     (interactive) mode the user may look at the triple difference residuals
     (if they have been saved in file), mark some observations, set new am-
     biguities etc. Usually the manual mode is used only if the results of
     the automatic run are not satisfactory.
     RECOMMENDED VALUE: AUTOMATIC

   FREQUENCY TO CHECK:
     This option is important for dual band data. For baselines longer than
     about 10 km the COMBINED option is mandatory. This option means, that
     the ionosphere-free linear combination of the L1 and L2 measurements
     is used for cycle slip detection. Option BOTH actually consists of the
     single frequency preprocessing for L1 and independently for L2.
     Attention: if the option COMBINED is used, observations with one fre-
     quency missing (either L1 or L2) are not checked. In this case it is
     recommended to mark such observations (see Marking the Observations in
     panel 4.4.2.2)
     RECOMMENDED VALUE: COMBINED

   SAVE SCREENED FILES:
     This option is important for automatic mode only. In the manual mode
     the user has still the possibility to save the screened files or not.
     If the screened files are not saved, all the changes made by MAUPRP
     are lost.
     RECOMMENDED VALUE: YES

   ADJUST FREQ./WLFAC.:
     It may happen that the selected options are not compatible with the
     files to be processed (number of frequencies in file, wave-length
     factors). If you specify YES here, the information is taken from the
     observation file.
     RECOMMENDED VALUE: YES

 Change Other Options:

   CHANGE OPTIONS:
     This option give you the possibility to start the program without
     looking at any more options. Use NO only if you are sure the options
     are set correctly from the previous run.

 Saving Coordinates:

   FIXED STATION:
     The station to be kept fixed may be selected by the user. If no sta-
     tion name is entered (blank) or "AUTO" is specified the program will
     select a station automatically. It is possible that more than one
     station will be fixed in a network which is divided into two or more
     independent parts: only one station to be fixed may be selected by the
     user (belonging to a first part or the network). MAUPRP will fix
     additional stations for the remaining parts automatically.
                                                                          LM
```

```
4.4.2-2                 NEW PREPROCESSING: INPUT 2

 Marking of Observations:
   USE MARKING FLAGS IN OBS FILES       > NO   <    (YES or NO)
```

```
  MARK OBSERVATIONS BELOW              > 20   <    degrees elevation
  MARK UNPAIRED OBSERVATIONS           > YES  <    (YES or NO)
  MIN.TIME INT. FOR CONTINUOUS OBS     > 301  <    seconds
  OBS STILL CONT IF GAPS SMALLER THAN  > 61   <    seconds

Non-Parametric Screening:
  PRINTING                             > SUMM <    (NO,SUMMary or ALL)
  SINGLE DIFF. SCREEN.                 > NO   <    (YES.. NO or ASIS
  DOUBLE DIFF. SCREEN.                 > YES  <    (YES.. NO or ASIS)
  MAX. INTERVAL OF FIT                 > 2    <    minutes

Triple Diff. Solution:
  FREQUENCY                            > L3   <    (L1,L2,L3 or L5)
  APRIORI COORD.SIGMAS                 > NO   <    (YES.. NO or ASIS)
  MAXIMUM OBSERVED-COMPUTED VALUE     > 999.0  <   meters
```

```
4.4.2-2             NEW PREPROCESSING: INPUT 2              HELP

Marking of Observations:

  USE MARKING FLAGS IN OBS FILES:
    If you specify YES here, all the observations already marked (e.g. in
    the previous run of MAUPRP, the markings are in the observation files)
    will not be checked anymore at any stage of the processing and remain
    marked. If you specify NO here, all observation markings read from the
    single-difference files will be reset before the checking and ALL
    observations will be checked.
    RECOMMENDED VALUE: NO

  MARK OBSERVATIONS BELOW:
    The observations with lower elevation are more corrupted by ionosphere
    and multipath. On the other hand the height component of the station
    position may be better estimated if the observations with lower eleva-
    tions are used. All observations below the cut-off angle specified are
    are marked. They are then neither checked nor used by the parameter
    estimation program GPSEST.
    RECOMMENDED VALUE: 20 or 15

  MARK UNPAIRED OBSERVATIONS:
    If YES is specified, all dual frequency observations where only L1 is
    present or only L2 will be marked. This option should always be set to
    YES. Especially when you use the option COMBINED
    (see {DAT4421_ PROCESSING MODE}), you should specify YES. Otherwise
    unchecked single frequency observations may remain in the data.
    RECOMMENDED VALUE: YES

  MIN.TIME INT. FOR CONTINUOUS OBS:
    The short intervals of observations (a few epochs only) are in general
    not important for the quality of the final solution. On the contrary,
    small pieces of data might indicate tracking problems and introducing
    a lot of new ambiguity parameters leads to greater a posteriori mean
    errors of the estimated parameters. It seems to be saver to mark these
    short intervals. This option defines "short interval" of observations.
    RECOMMENDED VALUE: a time interval which covers approximately 10 epochs

  OBS STILL CONT IF GAPS SMALLER THAN:
    It might happen that many observations are marked as "short intervals"
    just because of very short gaps in the data (e.g. just one epoch
    missing). It makes sense, therefore, to handle data with such short
    gaps still as being "continuous observations". If there is a gap in
    the data larger than the value specified here, the data will no
    longer be considered "continuous" and the check for "small data
    pieces", defined above, will be applied.
    RECOMMENDED VALUE: time interval about twice the sampling rate in the
      observation file -- e.g. if the sampling rate is 30 seconds you may
      use value 61 seconds.

Non-Parametric Screening:

  PRINTING:
    Non-parametric screening is the first part of the MAUPRP program. You
    can specify here what details you want to print into the program output
```

```
      file from this part of the program.
      RECOMMENDED VALUE: SUMM

    SINGLE DIFF. SCREEN.:
      Single difference screening may be good for debugging purposes only.
      Usually we do not use this option.
      RECOMMENDED VALUE: NO

    DOUBLE DIFF. SCREEN.:
      This option is mandatory. Exclude only for debugging. If you specify
      YES you will have the possibility to adjust additional options in
      panel {DAT42222}. Use ASIS only if these options are set correctly from
      the previous run.
      RECOMMENDED VALUE: YES

    MAX. INTERVAL OF FIT:
      In the first step MAUPRP checks whether or not the assumption be cor-
      rect, that the observations may be represented within an interval of a
      few minutes by a polynomial of degree q. This is done by computing the
      (q+1)-st derivative and by checking whether or not this quantity is
      zero (within 3 times its rms). If the assumption is correct the inter-
      val considered is shifted by one observation, if it is wrong, the last
      observation of the current interval is marked an replaced by the fol-
      lowing one. If the current interval gets longer than the value speci-
      fied here, all observations of the current interval are dropped, and
      the process is re-initialized. The interval has to be long enough to
      contain q+2 observation epochs -- the (q+1)-st derivative has to be
      computed. If a polynomial of degree one is used (see {DAT42222}) the
      interval has to contain at least three observation epochs. Do not use
      a large maximal interval of fit.
      RECOMMENDED VALUE: 2 minutes

  Triple Diff. Solution:

    FREQUENCY:
      You can specify which linear combination is used for the triple diffe-
      rence solution. For longer baselines the ionosphere-free linear combi-
      nation L3 is the best choice.
      RECOMMENDED VALUE: L3

    APRIORI COORD.SIGMAS:
      A priori sigmas may be assign to the station coordinates. It is a good
      idea to use these constrains if good a priori coordinates are already
      available. If you specify YES here you will have the possibility to
      adjust the a priori sigmas in panel {DAT42223}. ASIS means that the
      sigmas will be taken from panel 4.2.2.2.3 without any interaction.

    MAXIMUM OBSERVED-COMPUTED VALUE:
      Observations which give larger triple difference residuals than the
      specified value will not be used for the triple difference solution.
      In the program output these observations will be listed with the flag
      "O-C". If you have bad a priori coordinates you should use a value of
      999.9.
      RECOMMENDED VALUE: 0.5 meters
                                                                          LM
```

```
4.4.2-2.1 | AUTOMATIC PREPROCESSING: SINGLE DIFF. SCREENING

      Single Diff. Screening:
        POLYNOMIAL DEGREE         > 1 <
        DISCONTINUITY LEVEL     > .400  <     meters
```

```
4.4.2-2.1 | AUTOMATIC PREPROCESSING: SINGLE DIFF. SCREENING | HELP

    Single Diff. Screening:

    POLYNOMIAL DEGREE:
      In the first step MAUPRP checks whether or not the assumption is cor-
```

```
    rect, that the observations may be represented within an interval of a
    few epochs by a polynomial of degree q. This is done by computing the
    (q+1)-st derivative and by checking whether or not this quantity is
    zero (within 3 times its rms). Here you specify the polynomial degree.
    The single difference screening is rarely used.
    RECOMMENDED VALUE: 1

  DISCONTINUITY LEVEL:
    The program checks whether or not the (q+1)-st derivative is zero
    within 3 times its rms. Here you specify the rms.
    RECOMMENDED VALUE: 0.4 m
                                                                        LM
```

```
4.4.2-2.2            AUTOMATIC PREPROCESSING: DOUBLE DIFF. SCREENING

     Double Diff. Screening:
       POLYNOMIAL DEGREE         > 1 <
       DISCONTINUITY LEVEL     > .010  <     meters
```

```
4.4.2-2.2       AUTOMATIC PREPROCESSING: DOUBLE DIFF. SCREENING        HELP

  Double Diff. Screening:

  POLYNOMIAL DEGREE:
    In the first step MAUPRP checks whether or not the assumption is cor-
    rect, that the observations may be represented within an interval of a
    few epochs by a polynomial of degree q. This is done by computing the
    (q+1)-st derivative and by checking whether or not this quantity is
    zero (within 3 times its rms). Here you specify the polynomial degree.
    RECOMMENDED VALUE: 1

  DISCONTINUITY LEVEL:
    The program checks whether or not the (q+1)-st derivative is zero
    within 3 times its rms. Here you specify the rms.
    RECOMMENDED VALUE:  0.010 meters
                                                                        LM
```

```
4.4.2-2.3              AUTOMATIC PREPROCESSING: APRIORI WEIGHTS

     Apriori Weights:
       X-COORDINATE    > 0.1    <     meters
       Y-COORDINATE    > 0.1    <     meters
       Z-COORDINATE    > 0.1    <     meters
```

```
4.4.2-2.3          AUTOMATIC PREPROCESSING: APRIORI WEIGHTS            HELP

     Apriori Weights:
       A priori sigmas may be assign to the station coordinates (a value
       of zero is equivalent to "no a priori sigmas specified, solution not
       constrained). If you specify a priori sigmas they should reflect
       the accuracy of the a priori coordinates.
       RECOMMENDED VALUE: 0.1 m
                                                                        LM
```

```
 4.4.2-3                        NEW PREPROCESSING: INPUT 3
```

```
Slip Detection:
  PRINTING                            > SUMMARY <   (NO,SUMMARY or ALL)
  ACCEPT SLIPS GREATER THAN           > 0       <   cycles (half)
  TEST OBS WITH CYCLE SLIP FLAG ONLY    > NO  <     (YES or NO)
  L5 IS CLEAN (EXCEPT FLAGGED EPOCHS)   > NO  <     (YES or NO)

Sigmas:
  L1 OBSERVATIONS                     > 0.0011  <   meters
  L2 OBSERVATIONS                     > 0.0011  <   meters

Cycles or Half:
  SEARCH L1 FOR                       > CYCLES  <   (CYCLES or HALF)
  SEARCH L2 FOR                       > CYCLES  <   (CYCLES or HALF)

Search Widths:
  SEARCH WIDTH L1                       > 5   <     integers
  SEARCH WIDTH L5                       > 2   <     integers
```

```
4.4.2-3 | NEW PREPROCESSING: INPUT 3 | HELP

Slip Detection:

  PRINTING:
    Automatic cycle slip detection is the nucleus of program MAUPRP. Here
    you can specify how much information you want in program output.
    RECOMMENDED VALUE: SUMMARY

  ACCEPT SLIPS GREATER THAN:
    In earlier versions of the Bernese GPS Software cycle slips of a size
    smaller than the value specified here were not corrected for and left
    in the data (without marking). In the present version cycle slips
    smaller than the value given here are considered outliers (not real
    cycle slips, but seeming slips due to e.g. a high noise level) and are
    marked. If you have small cycle slips in your data (e.g. of 1-10
    cycles) that might not be real, you should set this option to 10
    cycles. This reduces the chances that a cycle slip is INTRODUCED into
    the data because of a high noise level (e.g. for low elevation data).
    RECOMMENDED VALUE: 0

  TEST OBS WITH CYCLE SLIP FLAG ONLY:
    If you use YES, it means that you rely on information (cycle slips
    flags) given in the observation files. Usually we do not use this
    possibility and we check all observations. If the receiver software
    would reliably mark any possible cycle slip, this option could be
    activated.
    RECOMMENDED VALUE: NO

  L5 IS CLEAN (EXCEPT FLAGGED EPOCHS):
    You can specify YES here only if you use dual band P-code receivers and
    you have checked the wide-lane linear combination successfully using
    the Melbourne-Wuebbena method (see program RNXCYC, menu 2.7.5).
    Usually we do not use this possibility even if P-code observations are
    available on both frequencies.
    RECOMMENDED VALUE: NO

Sigmas:

  L1 OBSERVATIONS, L2 OBSERVATIONS:
    These parameters have to be set only if you screen the data using the
    method "COMBINED" (see {DAT4421_ FREQUENCY TO CHECK}). They have an
    important effect on the cycle slip detection algorithm:
    If you specify a value which is too large (compared to the
    actual noise) the algorithm will find more than one acceptable possibi-
    lity to set the cycle slip values (in L1 and L2) at some epochs and
    will take the possibility with the smallest ionosphere change which is
    not necessary the correct one, especially on long baselines. If you
    specify a value that is too small the program will not find any suit-
    able choice at certain epochs and will mark a lot of observations or
    introduce many ambiguity parameters.
    The sigmas should be chosen within the limits 0.0008 - 0.0015 meters
    (corresponding to about 2.2 cm and 4.0 cm for the triple-difference L3
```

```
    residuals) and according to the quality of the receivers. Because the
    narrow-lane (with a wavelength of approximately 10 cm) plays an
    important role in the pre-processing, a sigma value larger than
    0.0018 m will allow any cycle slip to pass unnoticed.
    RECOMMENDED VALUE:  0.0012

Cycles or Half:

  SEARCH L1 FOR, SEARCH L2 FOR:
    Modern receivers provide full wavelength on both frequencies. Squa-
    ring receiver types have half cycle slips in L2. These options are
    active only if you specified "NO" for the option
    {DAT4221_ ADJUST FREQ./WLFAC}. Otherwise the program reads the
    wavelength factors (1 for full cycles, 2 for half cycles) from the
    observation file header.
    RECOMMENDED VALUE: CYCLES

Search Widths:

  SEARCH WIDTH L1, SEARCH WIDTH L5:
    Only used in the "COMBINED" method (see {DAT4421_ FREQUENCY TO CHECK}).
    These two options have a very important effect on the cycle slip detec-
    tion algorithm. They define the search range in L1 and L5 around the
    first guess for the cycle slip value (assuming that no ionosphere were
    present) to find the correct cycle slip value (in L1 and L5). Default
    values that make sense under most conditions are: 5 cycles in L1 and
    2 cycles in L5 assuming good quality receivers. In this case the
    ionospheric refraction should not be any problem.
    For squaring type receivers 4 cycles in L1 and 1 cycle in L5 may be
    a good choice assuming low ionospheric activity.
    RECOMMENDED VALUES: 2 and 5 respectively
                                                                        LM
```

```
4.4.2-4                  NEW PREPROCESSING: INPUT 4

Outlier Rejection:
  OUTLIER REJECTION                   > YES <    (YES or NO)
  MAX. OBSERV.GAP                    > 181   <   seconds
  MAX. IONOS.DIFF                    > 400   <   percents of L1 cycles

Setting of New Ambiguities:
  - IF CYCLE SLIP FLAG SET IN FILE     > NO  <    (YES or NO)
  - IF CYCLE SLIP DETECTION PROBLEM    > YES <    (YES or NO)
  - AFTER A GAP LARGER THAN           > 181   <   seconds
  USE AMBIGUITIES FROM FILE            > NO  <    (YES or NO)
  MINIMUM TIME INTERVAL PER AMBIGUITY > 301   <   seconds
```

```
4.4.2-4               NEW PREPROCESSING: INPUT 4                  HELP

Outlier Rejection:

  OUTLIER REJECTION:
    If you specify YES, MAUPRP marks the observations if a cycle slip
    cannot be reliable corrected.
    RECOMMENDED VALUE: YES

  MAX. OBSERV.GAP:
    This option prohibits MAUPRP to mark a long series of observations.
    The program marks at the most the specified interval of observations
    and then (if the cycle slip still cannot be corrected) introduces a
    new ambiguity parameter (see options to introduce new ambiguities
    below).
    RECOMMENDED VALUE: 181 seconds if 30-second data are processed

  MAX. IONOS.DIFF:
    Here you specify the maximum ionosphere change on the triple difference
    level (in % of the L1 wavelength, from one epoch to the next). A value
    of about 400 % may be appropriate for very long baselines. Do not use
```

```
    value smaller than about 50 %.
    RECOMMENDED VALUE: 400 percent for "COMBINED" mode
    RECOMMENDED VALUE:  30 percent for "L1", "L2", or "BOTH" mode

Setting of New Ambiguities:

  IF CYCLE SLIP FLAG SET IN FILE:
    Because MAUPRP can correct most of the cycle slips we recommend "NO".
    RECOMMENDED VALUE: NO

  IF CYCLE SLIP DETECTION PROBLEM:
    It is very important that MAUPRP introduces a new ambiguity parameter
    in case the cycle slip cannot reliably be corrected. Before setting up
    a new ambiguity MAUPRP will first try outlier rejection if allowed to
    do so (see above).
    RECOMMENDED VALUE: YES

  AFTER A GAP LARGER THAN:
    The test of the "no-cycle-slip" hypothesis is not reliable if the
    interval between two epochs is too large. Therefore it is better to
    introduce a new ambiguity parameter in this case. The setting of this
    option should correspond to the one of the option MAX. OBSERV.GAP
    (see above).
    RECOMMENDED VALUE: use the same value as for MAX. OBSERV.GAP

  USE AMBIGUITIES FROM FILE:
    This option allows you to introduce multiple ambiguity parameters pre-
    sent in the observation file headers. These ambiguities may be the
    result of running the program SNGDIF or they may stem from a previous
    MAUPRP run.
    RECOMMENDED VALUE: NO

  MINIMUM TIME INTERVAL PER AMBIGUITY:
    To avoid getting a huge number of ambiguities with only a few
    observations belonging to them, the minimum observation interval that
    should be associated with one ambiguity may be defined here. Intervals
    shorter than the minimum interval will be marked.
    RECOMMENDED VALUE: interval which covers about 10 epochs (e.g. 301 se-
      conds if 30 second data are used).

                                                                        LM
```

```
  4.5   |               PROCESSING: PARAMETER ESTIMATION

    CAMPAIGN         >          <    (blank for selection list)

  Job Identification:
    JOB CHARACTER       >   <        (blank, or A..Z, 0..9)

  Input Files:
    PHASE S.DIFF.    >          <    (NO, if not used; blank for sel.list)
    CODE  S.DIFF.    > NO       <    (NO, if not used; blank for sel.list)
    COORDINATES      >          <    (blank for selection list)
    STANDARD ORBIT   >          <    (blank for selection list)
    RAD.PRESS.COE.   > NO       <    (NO, if not used; blank for sel.list)
    IONOSP. MODELS   > NO       <    (NO, if not used; blank for sel.list)
    METEO DATA       > NO       <    (NO, if not used; blank for sel.list)
    ECCENTRICITIES   > NO       <    (NO, if not used; blank for sel.list)
    SATELL. CLOCKS   > NO       <    (NO, if not used; blank for sel.list)
```

```
  4.5   |            PROCESSING: PARAMETER ESTIMATION            |  HELP

General Remarks:

  The program GPSEST is the main parameter estimation program of the
  Bernese GPS Software. It allows the estimation of the following para-
  meters types
```

```
  ( 1) station coordinates,
  ( 2) receiver clock parameters,
  ( 3) orbital elements,
  ( 4) ambiguities,
  ( 5) receiver antenna offsets,
  ( 6) troposphere parameters for individual stations,
  ( 7) local ionosphere model parameters,
  ( 9) local troposphere model parameters,
  (10) earth rotation parameters,
  (11) stochastic orbit parameters,
  (12) satellite antenna offsets,
  (13) earth potential parameters,
  (14) resonance terms,
  (15) albedo parameters,
  (16) center of mass,
  (17) stochastic ionosphere parameters,
  (18) antenna phase center variations,
  (19) global ionosphere model parameters, and
  (21) epoch-specific station coordinates

based on a least-squares adjustment using double difference phase or/and
code measurements (interferometric processing technique). Note that the
numbers enclosed in brackets correspond to the internally used parameter
type numbers.
In addition, you have the possibility to combine GPSEST results on the
normal equation level by using the program ADDNEQ (see {DAT481__}). If you
plan to make use of this option please note that (a) you have to set up
all requested parameters in the GPSEST runs and (b) you have to save
the associated complete variance-covariance information (see
{DAT450__.PAN NORMAL EQUATIONS}).


Job Identification:

  JOB CHARACTER:
    If on a multitask system you would like to run more than one GPSEST
    program at the same time, you have to use different job identification
    characters to obtain unique input option files for the program GPSEST.
    Allowed characters are A through Z and 0 through 9 and blank. If the
    field is non-blank it will automatically be changed to the next
    character in alphabetic order for the next run.
    RECOMMENDED VALUE: blank

Input Files:

  PHASE S.DIFF.:
    Selection of the single difference phase file(s) to be processed.
    Several files/baselines may be processed in the same program run.
    RECOMMENDED VALUE: blank or wildcard

  CODE  S.DIFF.:
    Selection of the single difference code file(s) to be processed.
    Several files/baselines may be processed in the same program run.
    If you want to resolve wide-lane ambiguities analyzing the so-called
    Wuebbena-Melbourne linear combination of phase and (precise) code
    measurements (see {DAT451__ WUEBB}), you have to select the same
    code single difference files you selected for the phases. The code
    and phase baseline definitions have to be identical in this case (see
    {DAT43___ BASELINE DEFINITIONS}).
    RECOMMENDED VALUE: NO

  COORDINATES:
    Selection of an a priori coordinate file which contains all the sites
    you are processing. The a priori coordinates should be known within
    a few centimeters, otherwise you may do an additional iteration by
    introducing the saved estimates (see {DAT450__.PAN COORDINATES}) as
    new a priori values.
    RECOMMENDED VALUE: blank or wildcard

  STANDARD ORBIT:
    Selection of one standard orbit file containing the information on
    the satellite positions. Note that the orbit file specified has to
    cover all observation epochs to be processed.
    RECOMMENDED VALUE: blank or wildcard

  RAD.PRESS.COE.:
    The selection of a file containing a priori radiation pressure
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```
      coefficients (partial derivatives of the orbital parameters) is only
      necessary if you want to improve the orbits in this run.
      RECOMMENDED VALUE: NO

    IONOSP. MODELS:
      Selection of an ionosphere file containing local or global/regional
      ionosphere models is recommended when doing ambiguity resolution
      without using code measurements or when producing single-frequency
      solutions (e.g. with L1 measurements only). When processing the
      ionosphere-free (L3) linear combination you obviously do not need to
      specify any ionosphere model.
      RECOMMENDED VALUE: NO, if L3 processed, YES otherwise

    METEO DATA:
      Measured surface meteorological data may be used to compute the
      tropospheric zenith delays. If meteorological data files (one file
      per station) are specified, the option field in
      {DAT452__.PAN METEO DATA} is automatically set to "OBSERVED". Three
      examples of meteo files can be found in {X:\INX\EXAMPLE1.MET},
      {X:\INX\EXAMPLE2.MET}, and {X:\INX\EXAMPLE3.MET}. Enter "NO" if
      observed meteo data is not available.
      Under most circumstances the estimation of troposphere parameters
      (see {DAT452__ SPECIAL REQUESTS}) gives much better results than the
      use of meteorological data to correct the tropospheric delays. For
      regional and local networks a promising alternative might be the use
      of troposphere zenith delays from the CODE analysis center for the
      IGS sites in the network.
      RECOMMENDED VALUE: blank or wildcard (if available)

    ECCENTRICITIES:
      Optionally a site coordinate eccentricity file may be specified
      containing local ties between markers.

    SATELL. CLOCKS:
      Selection of a satellite clock file is recommended only, if there is a
      problem in terms of the receiver clock synchronization.
      RECOMMENDED VALUE: NO

                                                                           SS
```

```
 4.5-0                  PAR. ESTIMATION: OUTPUT FILES

    Output Files:
      COORDINATES          > NO       <    (NO, if not to be saved)
      ORBITAL ELEMENTS     > NO       <    (NO, if not to be saved)
      TROPOSPHERE PARAM.   > NO       <    (NO, if not to be saved)
      IONOSPHERE MODELS    > NO       <    (NO, if not to be saved)
      IONOSPHERE MAPS      > NO       <    (NO, if not to be saved)
      RESIDUALS            > NO       <    (NO, if not to be saved)
      COVARIANCES (COORD)  > NO       <    (NO, if not to be saved)
      COVARIANCES (ALL)    > NO       <    (NO, if not to be saved)
      NORMAL EQUATIONS     > NO       <    (NO, if not to be saved)
      EARTH ROTATION PARA. > NO       <    (NO, if not to be saved)
      POLE IN IERS FORMAT  > NO       <    (NO, if not to be saved)
      GENERAL OUTPUT       > NO       <    (NO, if standard name to be used)
```

```
 4.5-0                PAR. ESTIMATION: OUTPUT FILES                 HELP

    Output Files:

      COORDINATES:
        To save the station coordinates estimated from double difference
        phase (or/and code) observations enter a CRD file name here. If "NO"
        is specified coordinates are not saved.
        RECOMMENDED VALUE: file name (if coordinates estimated)

      ORBITAL ELEMENTS:
        To save the improved orbital elements including dynamical and
```

```
    stochastic orbit parameters enter an ELE file name here.
    RECOMMENDED VALUE: file name (if orbit improvement done)

  TROPOSPHERE PARAM.:
    To save the tropospheric zenith path delay parameters in a TRP file,
    which may be transferred to station-specific meteorological files
    running the program PRPMET by hand (without menu system).

  IONOSPHERE MODELS:
    To save local or global/regional ionosphere models in an ION file.
    These models may be used in subsequent runs in GPSEST (e.g. for
    ambiguity resolution) or MAUPRP.

  IONOSPHERE MAPS:
    To save global/regional ionosphere models in IONEX format.
    RECOMMENDED VALUE: NO

  RESIDUALS:
    The double difference residuals of the linear combination(s)
    processed are saved, if you enter a RES file name here. These
    residuals may be looked at or checked using menu 5.3.1 or 5.3.2.
    Please note that, if one or more parameter types are pre-eliminated
    at any stage (see {DAT45248}), it is no longer possible to save
    residuals in a residual file.
    RECOMMENDED VALUE: NO

  COVARIANCES (COORD):
    To save the variance-covariance submatrix associated with the
    station coordinates in a COV file, which may be used in the program
    COMPAR (see menu 5.4.1, {DAT541__ COVARIANCES}).

  COVARIANCES (ALL):
    To save the complete variance-covariance matrix in a COV file.
    Attention: such a file might become huge, if many parameters are
    estimated.
    RECOMMENDED VALUE: NO

  NORMAL EQUATIONS:
    In order to have the possibility to combine GPSEST results on the
    normal equation level, it is recommended to specify here a NEQ file
    name. Afterwards, the NEQ files collected may be selected in the
    program ADDNEQ to be "added" (see {DAT481__.PAN NORMAL EQUATIONS}).
    Please note that (a) it is not allowed to save normal equations when
    doing ambiguity resolution and (b) unresolved ambiguity parameters
    must be pre-eliminated (see {DAT451__ ELIMIN} or {DAT45248 AI}) if
    you want to save the normal equations.
    RECOMMENDED VALUE: NO

  EARTH ROTATION PARA.:
    To save earth rotation parameters in an ERP file. To re-introduce
    estimated ERPs you have to copy the ERP file into the general
    directory X:\GEN\ and change the ERP filename in panel
    {DAT031__.PAN POLE INFORMATION}.

  POLE IN IERS FORMAT:
    To save earth rotation parameters in an IEP file (the format for
    the submission of ERP results to the IERS and to the IGS and for
    the program POLXTR (see menu 5.5.2).
    RECOMMENDED VALUE: NO

  GENERAL OUTPUT:
    It is recommended to specify an OUT file name for the GPSEST
    program output if you want to give it a meaningful name. Normally
    the program output goes into a file named GPSEST.Lnn or GPSEST.nnn
    (see {DAT01___ DIGITS OF JOB OUTPUT NUMBER}). Having well-defined
    names for the GPSEST program output is also important if you want
    to obtain a summary files of an ensemble of GPSEST output files
    by running the GPSEST output extraction program with a correspond-
    ing wildcard in {DAT565__.PAN GENERAL OUTPUT FILE} to include
    exactly the files requested. Enter "NO" to handle the naming of
    the job output files as usual (generating GPSEST.Lnn or GPSEST.nnn).
    RECOMMENDED VALUE: NO
                                                                      SS
```

```
 4.5-1  |             PARAMETER ESTIMATION: INPUT 1
-------------------------------------------------------------------------
  TITLE    >                                                       <

  Frequency:
    FREQUENCY           > L3    <    (L1,L2,L3,L4,L5,L1&L2,L3&L4,MIXED,
                                      or WUEBBena/Melbourne)
  Fixed Station(s):
    STATION      >               <    (blank for sel.list, ALL or NONE,
  Kin.  Station(s):                    SPECIAL_FILE.. $FIRST, $LAST)
    STATION      > NONE          <    (blank for sel.list, ALL or NONE,
                                       SPECIAL_FILE.. $FIRST, $LAST)
  Ambiguities:
    RESOL. STRATEGY     > ELIMIN <   (ROUND,SIGMA..SEARCH..ELIMIN,QIF..NO)
    INTRODUCE WIDELANE  > NO  <      (YES or NO)
    INTRODUCE L1 AND L2 > NO  <      (YES or NO)
    SAVE AMBIGUITIES    > NO  <      (YES or NO)
  Observation selection:
    MIN. ELEVATION      > 20    <    degrees
    SAMPLING RATE       > 0     <    sec (0: all observations)
    OBSERV. WINDOW      > NO    <    (YES.. NO or ASIS)
```

```
 4.5-1  |            PARAMETER ESTIMATION: INPUT 1            |  HELP
-------------------------------------------------------------------------

  TITLE:
    This title line will be printed as header comment in the program output
    and will be saved in all the result files specified in {DAT450__.PAN}
    to document the program run. The title should characterize the program
    run by e.g. giving the most important options used and the session.

  Frequency:

    FREQUENCY:
      Here you may select one or two frequencies (linear combinations) to
      be processed.
      L1:
        First frequency. This frequency we prefer to use when processing
        "small" high-precision control networks (with an extent of few
        kilometers only) taking into account local or global/regional
        ionosphere models (see {DAT45___ IONOSP. MODELS}).
      L2:
        Second frequency.
      L3:
        Ionosphere-free linear combination (LC) of dual-band measurements.
        This LC - which totally eliminates the ionospheric refraction
        effects - is recommended to be used for most networks.
        By introducing already resolved wide-lane (L5) ambiguities (see
        {DAT451__ INTRODUCE WIDELANE") you get an observable which may be
        used to resolve the so-called narrow-lane (L1) ambiguities. One
        narrow-lane cycle corresponds to a wavelength of about 11 cm only.
        Please note that "L3-ambiguities" are real-valued when no wide-lane
        (L5) ambiguities are introduced, i.e. in this case ambiguity
        resolution cannot be done!
      L4:
        Geometry-free LC of dual-band measurements which corresponds to the
        difference L1-L2 (in meters). This LC is useful when monitoring the
        ionosphere and recommended when producing ionosphere models.
      L5:
        Wide-lane LC of dual-band measurements. In principle this LC is
        only used to resolve the wide-lane (L5) ambiguities without code
        measurements on "medium" baselines (with lengths of few hundred
        kilometers only). One wide-lane cycle corresponds to a wavelength
        of about 86 cm which is quite large compared to the ionospheric
        (and tropospheric) biases expected. The site coordinates should
        be fixed to a previously computed L3-solution, when resolving the
        wide-lane ambiguities.
      L1&L2:
        Both frequencies. The parallel processing of both frequencies is
        recommended when resolving ambiguities with the "SEARCH" strategy.
        For the  "QIF" strategy both frequencies have to be processed in
        parallel and the setting of "L1&L2" is mandatory.
      L3&L4:
        Ionosphere-free and geometry-free LCs. Please do not use.
```

```
    MIXED:
      To select the frequencies depending on baselines enter "MIXED" and
      you will get a scratch panel where you may specify one or two
      frequencies requested for each baseline by entering "n" or "n m"
      (e.g. "1 2" for a parallel processing of L1 and L2). See also
      {DAT452__ FREQUENCY}.
    WUEBB:
      Melbourne-Wuebbena linear combination of dual-band phase and code
      measurements is recommended to be used when resolving the wide-lane
      (L5) ambiguities with "precise" code measurements. This LC is free
      of hypotheses concerning the ionosphere and the "geometry" - where
      "geometry" includes the troposphere, the satellite orbits (and
      clocks) as well as the station coordinates (and clocks).
      In order to use this option you have to select both, phase AND code
      single-difference files in panel {DAT45___}.
    RECOMMENDED VALUE: L3

Fixed Station(s):

  STATION:
    Here you may specify requests concerning the fixing of station
    coordinates.
    blank:
      To get a selection list of all stations involved.
    SELECTED:
      To use the selection file of the previous run.
    ALL:
      To keep fixed all station coordinates on their a priori values is
      recommended when processing the "L4", "L5", or "WUEBB" LC.
    NONE:
      To leave all stations "free" is recommended when saving normal
      equations (see {DAT4524_ A PRIORI SIGMAS FOR SITE COORDINATES}).
    SPECIAL_FILE:
      You may create a file to define site-specific requests concerning
      the site fixing. See {DAT4515_ STATIONS FILE} to get more
      information.
    $FIRST:
      To select the first station.
    $SECOND:
      To select the second station.
    $LAST:
      To select the last station involved.
    RECOMMENDED VALUE: blank

Kin.  Station(s):

  STATION:
    Here you may specify requests concerning the set-up of epoch-specific
    station coordinates.
    RECOMMENDED VALUE: NONE

Ambiguities:

  RESOL. STRATEGY:
    Initial carrier phase ambiguities may be resolved/handled in several
    ways. Note that ambiguity resolution is usually done baseline by
    baseline.
    ROUND:
      The simplest ambiguity resolution (AR) strategy which only rounds
      the real-valued estimates to their nearest integers without using
      any variance-covariance information.
    SIGMA:
      The sigma-dependent strategy makes use of the full variance-
      covariance information. This "standard" AR strategy is useful for
      linear combinations like "L1", "L2", "L3" (with wide-lane), "L5",
      "L1&L2", and "WUEBB". More information concerning the "SIGMA" AR
      strategy can be found in {DAT4511_}.
    SEARCH:
      The general search strategy includes essential elements of the
      Fast Ambiguity Resolution Algorithm (FARA) but is generalized to be
      applicable for all linear combinations. This AR strategy is very
      powerful for data taken in the rapid static observation scenario
      (with "L1&L2") or the re-occupation scenario (with "L1&L2" or only
      "L1"). More information concerning the "SEARCH" AR strategy can be
      found in {DAT4513_}.
    ELIMIN:
      To pre-eliminate the (unresolved) ambiguity parameters is
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        recommended (a) when processing multi-baseline solutions and (b)
        when saving normal equations (see {DAT450__ NORMAL EQUATIONS}).
        Please note that you may also request the pre-elimination of
        ambiguity parameters in panel {DAT45248.PAN} by entering "BI" or
        "AI" (see {DAT45248}).
      QIF:
        The Quasi-Ionosphere-Free (QIF) AR strategy allows to directly
        resolve L1 and L2 ambiguities even on long baselines (with lengths
        up to 1000/2000 kilometers) without using the code measurements.
        Note that this AR strategy requires in addition the estimation of
        stochastic ionosphere parameters (see
        {DAT4524_ STOCHASTIC IONOSPHERE PARAMETERS}). L1 and L2 observa-
        tions have to be processed in parallel. More information
        concerning the "QIF" AR strategy can be found in {DAT4514_}.
      NO:
        Ambiguity parameters are not pre-eliminated and not resolved.
      RECOMMENDED VALUE: ELIMIN

    INTRODUCE WIDELANE:
      To introduce the previously resolved wide-lane ambiguities is
      necessary when resolving narrow-lane ambiguities with L3.
      RECOMMENDED VALUE: NO

    INTRODUCE L1 AND L2:
      You may produce (a) an ambiguity-free solution by selecting "NO" or
      (b) an ambiguity-fixed solution by selecting "YES" - if L1 and L2/L5
      ambiguities are already resolved. We recommend to produce an ambi-
      guity-fixed solution as final solution by introducing the known
      integers.
      RECOMMENDED VALUE: NO

    SAVE AMBIGUITIES:
      To save the integer values of resolved ambiguities (L1/L2 or L5) in
      the corresponding observation header (PSH) files is recommended when
      doing ambiguity resolution (see "RESOL. STRATEGY").
      RECOMMENDED VALUE: NO

  Observation selection:

    MIN. ELEVATION:
      Only phase/code observations above the elevation cut-off angle
      specified here will be used in the parameter estimation program.
      RECOMMENDED VALUE: 15 degrees

    SAMPLING RATE:
      You may wish to process sampled observation epochs, i.e. only one
      epoch per n seconds. This time span can be specified here. If "0" is
      entered no data sampling will be done, i.e. all observation epochs
      will be used. In many cases the processing time may be considerably
      reduced by sampling the data without loss of accuracy.
      RECOMMENDED VALUE: 0 sec (all observations)

    OBSERV. WINDOW:
      YES:
        The panel {DAT4512_.PAN} will be displayed where you may enter the
        observation window to be processed.
      NO:
        All observations will be processed.
      ASIS:
        By entering "ASIS" the values specified last time - still present
        in the panel {DAT4512_.PAN} - will automatically be used without
        displaying the panel to you. If you are not sure what values you
        entered last time, you better say "YES" to verify the panel.
      RECOMMENDED VALUE: NO

                                                                       SS
```

```
4.5-1.1   |            PARAMETER ESTIMATION: AMBIGUITY RESOLUTION

 Sigma-Dependent Ambiguity Resolution:
   MAX. NUMBER OF AMB. SOLVED IN ONE ITERATION STEP  > 1    <   (0:All)
   AMBIGUITY RESOLVABLE IF EXACTLY 1 INTEGER WITHIN  > 4    <    sigma
   MAXIMAL SIGMA OF A RESOLVABLE AMBIGUITY           > 0.07 <    cycles
```

```
MINIMAL SIGMA OF AMBIGUITY USED FOR TESTS         > 0.05 <    cycles
```

```
4.5-1.1 | PARAMETER ESTIMATION: AMBIGUITY RESOLUTION | HELP

Sigma-Dependent Ambiguity Resolution:

  MAX. NUMBER OF AMB. SOLVED IN ONE ITERATION STEP:
    Maximum number of ambiguities to be solved in one iteration step. After
    each iteration step an inversion of the complete normal equation matrix
    is done once again holding the resolved ambiguities on their integer
    values. In this way we increase the chance of the remaining ambiguity
    parameters to be resolved because of the decreasing formal accuracies
    of the ambiguities with increasing degree of freedom.
    By entering "0" all ambiguity parameters which fulfill the resolution
    criteria specified below are fixed in one step. Even in this case
    additional ambiguity pairs may be resolved in further iteration steps
    due to the boot-strapping mentioned above.
    RECOMMENDED VALUE: 1

  AMBIGUITY RESOLVABLE IF EXACTLY 1 INTEGER WITHIN:
    Ambiguities are solvable if there lies exactly one integer within the
    two-tailed confidence interval based on the real-valued estimates, the
    a posteriori RMS errors, and the factor of the Student t-distribution
    function. This confidence interval is specified here.
    RECOMMENDED VALUE: 3 sigma

  MAXIMAL SIGMA OF A RESOLVABLE AMBIGUITY:
    All possible double-difference ambiguity parameters with an RMS error
    smaller than the maximal sigma specified here (in units of cycles
    of the observable processed) are first sorted according to their RMS
    errors. Note that the wavelengths of the mostly formed linear
    combinations are about 19.0 cm for L1, 24.4 cm for L2, 86.2 cm for
    the wide-lane LC (L5), and 10.6 cm for the narrow-lane LC (L3 with
    introduced L5 ambiguities).
    Starting with the ambiguity parameter with the best RMS error the
    ambiguity resolution algorithm tests whether the associated fractional
    part is smaller than the maximal sigma entered here. Otherwise the next
    double-difference ambiguity from the sorted list is checked in the
    same way, and so on.
    RECOMMENDED VALUE: 0.07 cycles

  MINIMAL SIGMA OF AMBIGUITY USED FOR TESTS:
    In addition you may define a minimum sigma which is used in the
    statistical test if the RMS error of an ambiguity is smaller than
    this limit. This is necessary, because often the formal RMS errors
    are too small and obviously resolvable ambiguities will remain
    unresolved due to the sigma-dependent test (see option AMBIGUITY
    RESOLVABLE IF EXACTLY 1 INTEGER WITHIN above).
    RECOMMENDED VALUE: 0.06 cycles

                                                                          SS
```

```
4.5-1.2 | PARAMETER ESTIMATION: OBSERVATION WINDOWS

                 START DATE                   END DATE

            yy mm dd     hh mm ss        yy mm dd     hh mm ss

          >          < >          <   >          < >          <
```

```
4.5-1.2 | PARAMETER ESTIMATION: OBSERVATION WINDOWS | HELP
```

```
 START TIME, END TIME:
   This input panel is used to specify an observation window of the data
   to be processed. The window will be the same for all the observation
   files of this program run. Window start and end times are given as year,
   month, day, hour, minute, and second.
   If you would like to process observation files with different time
   windows in the same program run you have to edit the input option file
   U:\INP\GPSESTF.INP (or U:\INP\GPSESTF.INx if you use the special job
   character "x" to prepare this run, see {DAT45___}) before submitting the
   the job. (Use the option in {DAT01___} to prevent the job from starting
   immediately after the menu program has been completed).

   EXAMPLE:

                 START DATE                   END DATE

            yy mm dd     hh mm ss       yy mm dd     hh mm ss

          > 95 11 04 < > 00 00 00 <   > 95 11 04 < > 02 00 00 <

                                                                          SS
```

```
4.5-1.3 |            PARAMETER ESTIMATION: AMBIGUITY RESOLUTION

 General Search Strategy:
   BASELINE-WISE AMBIGUITY RESOLUTION                    > YES <  (YES,NO)

   SEARCH WIDTH IN UNIT OF STD. DEV.                    >  5    <
   MAXIMUM ALLOWED RMS(FIXED)/RMS(FLOAT)                >  2    <
   MINIMUM ALLOWED RMS(2-ND AMB)/RMS(1-ST BEST AMB)     >  1.4  <
   SEARCH WIDTH FOR GEOMETRY-FREE LC (L1 CYCLES)        >  0.1  <
```

```
4.5-1.3 |         PARAMETER ESTIMATION: AMBIGUITY RESOLUTION          | HELP

 General Search Strategy:

   BASELINE-WISE AMBIGUITY RESOLUTION:
     Ambiguity resolution using the general search strategy is recommended
     to be done baseline by baseline. In this case the normal equation
     system is divided into baseline-specific parts which are manipulated
     one after the other. Enter "NO" to do the general search in one step
     using the complete normal equation system. You may ignore this option
     when you process an individual baseline only.
     RECOMMENDED VALUE: YES

   SEARCH WIDTH IN UNIT OF STD. DEV.:
     To quantify the search range for all ambiguity parameters (and all
     possible differences including wide-lane ambiguities) you may specify
     a search width in units of standard deviations which should correspond
     to the factor of the Student t-distribution function as a function of
     degree of freedom and a significance level which has to be assumed.
     To find the true set of integers (a) all compatible ambiguity vectors
     are generated after statistically testing all possible values,
     differences, and geometry-free LCs, (b) for each accepted ambiguity
     vector a least-squares adjustment is performed, and finally (c) the
     ambiguity vectors are sorted according to their resulting RMS error.
     At the end the ambiguity vector of the best solution (with the smallest
     RMS) has to fulfill two additional statistical tests to be accepted
     as the true one - otherwise the ambiguity resolution has failed.
     RECOMMENDED VALUE: 5.0

   MAXIMUM ALLOWED RMS(FIXED)/RMS(FLOAT):
     The ratio between the a posteriori RMS errors of the (best) ambiguity-
     fixed and the ambiguity-float solution must be smaller than the value
     specified here. This test value may be obtained by evaluating the
     Chi**2-distribution function as a function of both degrees of freedom
     and an assumed significance level.
```

```
    RECOMMENDED VALUE: 2.0

  MINIMUM ALLOWED RMS(2-ND AMB)/RMS(1-ST BEST AMB):
    Furthermore the ratio between the a posteriori RMS errors of the second
    best and the best ambiguity-fixed solution must be greater than the
    value specified here to successfully finish the ambiguity resolution.
    This test value may be obtained again by evaluating the Chi**2-
    distribution function.
    RECOMMENDED VALUE: 1.4

  SEARCH WIDTH FOR GEOMETRY-FREE LC (L1 CYCLES):
    Here you may specify a "hard-wired" search width for the geometry-free
    (L4) linear combination of L1 and L2 ambiguities when processing dual-
    frequency observations (see {DAT451__ L1&L2}) which are biased
    by the ionosphere. If you enter "0.0", the L4 search width is derived
    from the formal accuracy and the t-factor specified above.
    Please note that you may ignore this option when processing single-
    frequency data only.
    RECOMMENDED VALUE: 0.1

                                                                          SS
```

```
4.5-1.4      PARAMETER ESTIMATION: AMBIGUITY RESOLUTION: QIF STRATEGY

 Quasi-Ionosphere-Free Ambiguity Resolution:
   MAX. NUMBER OF AMB. SOLVED IN ONE ITERATION STEP  > 1    <     (0:All)
   SEARCH WIDTH IN WIDE-LANE CYCLES                  > 0.50  <     cycles
   MAX. RMS OF RESOLVABLE NARROW-LANE AMBIGUITY      > 0.03  <     cycles
   MAX. FRACT. PART OF RESOLVABLE NL AMBIGUITY       > 0.10  <     cycles
```

```
4.5-1.4    PARAMETER ESTIMATION: AMBIGUITY RESOLUTION: QIF STRATEGY    HELP

 Quasi-Ionosphere-Free Ambiguity Resolution:

  MAX. NUMBER OF AMB. SOLVED IN ONE ITERATION STEP:
    Maximum number of ambiguity pairs (L1 and L2) to be solved in one
    iteration step. After each iteration step an inversion of the complete
    normal equation matrix is done holding the resolved ambiguities on
    their integer values. In this way we increase the chance to resolve
    the remaining ambiguity parameters because of the decreasing formal
    accuracies of the ambiguities with increasing degree of freedom.
    By entering "0" all ambiguity pairs which fulfill the resolution
    criteria specified below are fixed. Even in this case additional
    ambiguity pairs may be resolved in further iteration steps due to the
    boot-strapping mentioned above.
    RECOMMENDED VALUE: 1

  SEARCH WIDTH IN WIDE-LANE CYCLES:
    This value specifies the search width for the wide-lane (L5) linear
    combination of the L1 and L2 ambiguity parameters. The L5 search width
    should be chosen smaller than 2 minus the maximum ionospheric bias on
    L5 (in L5 cycles) to be expected. You may apply an ionosphere model
    to support the QIF strategy (see {DAT45___.PAN IONOSP. MODELS}).
    RECOMMENDED VALUE: 0.50 cycles

  MAX. RMS OF RESOLVABLE NARROW-LANE AMBIGUITY:
    All possible double-difference ambiguity pairs, where the RMS error of
    the ionosphere-free (L3) linear combination of the L1 and L2 ambiguity
    parameter are smaller than the maximum RMS error specified here (in
    units of narrow-lane cycles), are sorted according to their RMS errors.
    Note that the wavelength of the narrow-lane observable corresponds to
    about 10.6 cm.
    RECOMMENDED VALUE: 0.03 cycles

  MAX. FRACT. PART OF RESOLVABLE NL AMBIGUITY:
    Starting with the ambiguity pair with the best RMS error the ambiguity
    resolution algorithm does a search in the (L1,L5) ambiguity space using
    the L5 search width specified above. A pair of integers (L1 and L2) is
```

```
    accepted as true ambiguity set if the associated fractional part of the
    narrow-lane ambiguity parameter is smaller than the maximum value
    entered here. Otherwise the next pair from the list of sorted
    ambiguity pairs is checked in the same way, and so on.
    RECOMMENDED VALUE: 0.10 cycles

Additional Remark:

  Please do not use the QIF ambiguity resolution strategy if data from
  squaring type receivers is processed!

                                                                        SS
```

4.5-1.5	GPSEST: SELECTION OF SPECIAL FIXED STATION FILE

```
  STATIONS FILE     >         <  (blank for selection list)
```

4.5-1.5	GPSEST: SELECTION OF SPECIAL FIXED STATION FILE	HELP

```
  STATIONS FILE:
    Stations which are listed in this file without giving any a priori
    weights will be fixed on their a priori coordinates. An example is
    shown in {X:\INX\EXAMPLE.FIX}. The extension of the corresponding file
    name can be found in {DAT034__.PAN SPECIAL FIXED STAT FILE}.
    This station file may also be used to define station-specific a priori
    weights for the three coordinate components (see {DAT4524B}).
    RECOMMENDED VALUE: blank

                                                                        SS
```

4.5-1.6	GPSEST: SELECTION OF SPECIAL TROPOSPHERE SIGMA FILE

```
  TROPOSPHERE SIGMAS  >         <  (blank for selection list)
```

4.5-1.6	GPSEST: SELECTION OF SPECIAL TROPOSPHERE SIGMA FILE	HELP

```
  TROPOSPHERE SIGMAS:
    You may create files to define station-specific a priori sigmas for the
    tropospheric parameters. An example is shown in {X:\INX\EXAMPLE.SIG}
    containing station names, "absolute" and "relative" sigmas. No sigmas
    will be applied when "0.0000" is given. For a station listed in the
    file without any sigmas (blank) the estimation of tropospheric
    parameters will be suppressed.
    The extension of the corresponding file name is specified in
    {DAT034__.PAN TROPOSPHERE APRIORI SIGMA}.
    RECOMMENDED VALUE: blank

                                                                        SS
```

4.5-1.7	GPSEST: SELECTION OF KINEMATIC STATION FILE

```
  STATIONS FILE     >         <  (blank for selection list)
```

```
4.5-1.7   GPSEST:  SELECTION OF KINEMATIC STATION FILE   HELP

  STATIONS FILE:
    Set up epoch-specific coordinates for all stations listed in this file.
    An example is shown in {X:\INX\EXAMPLE.FIX}. Note that only the
    station names have to be contained in the file.
    RECOMMENDED VALUE: blank

                                                                        SS
```

```
4.5-2                 PARAMETER ESTIMATION: INPUT 2

  Atmosphere Models:
    METEO DATA         > EXTRAPOLATED <  (EXTRAPOLATED or OBSERVED)
    TROPOSPH. MODEL    > SAASTAMOINEN <  (SAASTAMOINEN,HOPFIELD,
                                          ESSEN-FROOME,DRY_SAAST,
                                          DRY_HOPFIELD, or NO)
  Statistics:
    CORRELATIONS       > BASELINE     <  (CORRECT, FREQUENCY, or BASELINE)
    CORREL. INTERVAL      > 1      <      sec
    A PRIORI SIGMA        > 0.002  <      m

  Further Options:
    PRINTING               > NO   <       (YES.. NO or ASIS)
    HELMERT                > NO   <       (YES.. NO or ASIS)
    ORBIT ADJUSTMENT       > NO   <       (YES.. NO or ASIS)
    SPECIAL REQUESTS       > YES  <       (YES.. or NO)
```

```
4.5-2               PARAMETER ESTIMATION: INPUT 2               HELP

  Atmosphere Models:

    METEO DATA:
      EXTRAPOLATED:
        To use the troposphere model chosen below (next input field) with
        extrapolated meteorological data based on a standard atmosphere.
        The starting values at sea level to compute pressure, temperature,
        and humidity at the height of the station (standard atmosphere) are
        given in the file {X:\GEN\CONST.}.
      OBSERVED:
        To use the troposphere model chosen below with observed meteoro-
        logical data. The meteorological data files have to be entered in
        {DAT45___ METEO DATA} in this case.
      RECOMMENDED VALUE: EXTRAPOLATED (if no meteo data available)

    TROPOSPH. MODEL:
      There are several possibilities to model the tropospheric delay.
      The models SAASTAMOINEN, HOPFIELD, AND ESSEN-FROOME are including
      the dry and wet component of the tropospheric delay, whereas the
      models DRY_SAAST and DRY_HOPFIELD take into account the dry part
      only.
      ESSEN-FROOME: This model is what we call a "differential" model. It
        models the troposphere delay in the atmospheric layer between the
        lowest and the highest site. For the troposphere delay above the
        highest station, the Saastamoinen model is applied.
      NO:
        To suppress the use of an a priori troposphere model is not
        recommended (for test purposes only).
      RECOMMENDED VALUE: SAASTAMOINEN

  Statistics:

    CORRELATIONS:
      CORRECT:
        The mathematical correlations between the double-difference
        observations are handled correctly even when processing several
```

```
      baselines of a network. This correlation strategy is recommended
      when producing "final" solutions, because mathematically and
      statistically it is the correct method to use. If more than about
      30-40 sites are processed with correct correlations, the resources
      needed by GPSEST (CPU time, memory, ...) might become critical.
      A comprise consists of a processing in clusters of sites with full
      correlations taken into account within each cluster.
      All the observation files of one session are open simulta-
      neously when using "CORRECT".
      Correlations between different linear combinations are also
      correctly modeled (e.g. when processing L1 for some baselines and
      L3 for others).
    FREQUENCY:
      With this option correlations are correctly handled within each
      linear combination or frequency. When processing L1 baselines and
      L3 baselines together the correlations within the L1 baselines
      and the correlations within the L3 baselines are dealt with sepa-
      rately. This option was sometimes used to avoid, that the scale in
      the L1 baselines (due to the ionosphere) would affect the L3 base-
      lines through the correlations. A better method is the use of an
      appropriate ionosphere model to get rid of the scale.
    BASELINE:
      Only the correlations within each baseline are correctly modeled.
      Specifying "BASELINE" also means, that each baseline is processed
      sequentially (and not in parallel as in the case of correct
      correlations). Each single difference file is then considered to
      be one session internally. Especially when pre-eliminating ambi-
      guities (see {DAT451__ RESOL. STRATEGY}) this "baseline mode" is
      very efficient, because it only needs space in memory for the
      ambiguity parameters of one baseline. After one baseline has been
      processed the ambiguities are pre-eliminated from the normal
      equation system and the ambiguity parameters of the next baseline
      may use their space.
    RECOMMENDED VALUE: BASELINE

  CORREL. INTERVAL:
    The correlation matrix will be computed for all the observations that
    are "simultaneous", where "simultaneous is defined by the time
    interval specified here. If you are processing 1 sec data you better
    change the time interval to a fraction of a second, else observations
    that belong to different epochs might be processed together and thus
    correlated.
    RECOMMENDED VALUE: 1 sec

  A PRIORI SIGMA:
    Here you may specify an a priori sigma of the unit of weight, which
    is referring one zero difference phase observation. This a priori
    sigma should approximately agree with the actual measurement noise
    of the zero-difference phase observations (the a posteriori observa-
    tion rms given in the GPSEST output divided by square-root of 2).
    The value of this sigma is relevant only for the correct scaling of
    any a priori sigmas put on specific parameters. When changing the a
    priori sigma here, you also change the strength of any a priori con-
    straints.
    Please note that you may also specify satellite-specific sigmas
    (see option "SPECIAL REQUESTS" below).
    RECOMMENDED VALUE: 0.002 m

Further Options:

  PRINTING:
    To select additional printing options (see {DAT4512_}) enter "YES" or
    "ASIS".
    RECOMMENDED VALUE: NO

  HELMERT:
    To automatically compute a Helmert transformation between the
    station coordinates estimated and their a priori values (see
    {DAT4522_}) enter "YES" or "ASIS".
    RECOMMENDED VALUE: NO

  ORBIT ADJUSTMENT:
    To set up orbital elements including dynamical and stochastic orbit
    parameters (see {DAT4523_} and {DAT45231}) enter "YES" or "ASIS".
    RECOMMENDED VALUE: NO (when precise ephemerides available)

  SPECIAL REQUESTS:
```

```
      To specify a priori sigmas for site coordinates, to set up additional
      types of parameters like
      - site-specific troposphere parameters,
      - stochastic ionosphere parameters,
      - global/regional ionosphere model parameters,
      - earth orientation parameters,
      - coordinates of center of mass,
      - satellite antenna offsets, and
      - receiver clock errors,
      to request parameter pre-elimination, or/and to specify satellite-
      specific a priori sigmas enter "YES" here (see {DAT4524_}).
      RECOMMENDED VALUE: YES

  Additional Remark:

    There are some options in this panel where you may enter "ASIS".
    Please note that by entering "ASIS" the values specified last time -
    still present in the panel - will automatically be used without
    displaying the panel to you. If you are not sure what values you
    entered last time, you better say "YES" to verify the panel.

                                                                       SS
```

```
4.5-2.1                  PARAMETER ESTIMATION: PRINTING

  Print:
    NUMBER OF OBSERV. IN FILES           > NO  <      (YES or NO)
    POS.ECCENT./RECEIVER INFO            > NO  <      (YES or NO)
    CLOCK POLYNOMIAL COEFF.              > NO  <      (YES or NO)
    AMBIGUITIES IN FILES                 > NO  <      (YES or NO)
    PARAMETER CHARACTERIZATION           > NO  <      (YES or NO)
    CONSTANTS, ANT. OFFSETS, ION. COEFF. > NO  <      (YES or NO)
    SATELLITE ELEVATIONS                 > NO  <      (YES or NO)
    SYNCHRONIZATION ERRORS               > NO  <      (YES or NO)
    NUMBER OF DBL.DIFF.OBSERV.           > NO  <      (YES or NO)
    AMBIGUITIES FOR EACH ITERATION STEP  > NO  <      (YES or NO)
```

```
4.5-2.1               PARAMETER ESTIMATION: PRINTING               HELP

  Print:

    NUMBER OF OBSERV. IN FILES:
      Printing of the number of observations present in the observation
      files for each satellite into the GPSEST program output file. Note
      that not the number of observations actually processed in a GPSEST
      run are printed.
      RECOMMENDED VALUE: NO

    POS.ECCENT./RECEIVER INFO:
      Printing of antenna heights, receiver and antenna names and numbers,
      etc.
      RECOMMENDED VALUE: NO

    CLOCK POLYNOMIAL COEFF.:
      Option not available anymore.
      RECOMMENDED VALUE: NO

    AMBIGUITIES IN FILES:
      Printing of all the ambiguity information contained in the observa-
      tion header files. This only includes all the a priori ambiguity
      information, and not the results of the current run. (Those are
      printed anyway).
      RECOMMENDED VALUE: NO

    PARAMETER CHARACTERIZATION:
      Printing of a list of all parameters that are set up in GPSEST with
      their characterization. This list represents the initial set up of
      parameters and does not the final status (parameters may be removed
```

```
      from the normal equation, if no observations contribute to their
      estimation, or parameters may be pre-eliminated). Epoch-specific
      parameters are not contained in the list, if they are pre-eliminated
      after each epoch processed.
      RECOMMENDED VALUE: NO

    CONSTANTS, ANT. OFFSETS, ION. COEFF.:
      Printing of the general constants used, the a priori antenna phase
      center offsets and variations, and the coefficients of the ionosphere
      models introduced into the GPSEST run.
      RECOMMENDED VALUE: NO

    SATELLITE ELEVATIONS:
      A table of satellite elevations is printed for each session processed.
      RECOMMENDED VALUE: NO

    SYNCHRONIZATION ERRORS:
      Printing of the receiver synchronization errors as derived from the
      single-difference observed-computed values. Only for debug purposes.
      RECOMMENDED VALUE: NO

    NUMBER OF DBL.DIFF.OBSERV.:
      Printing of the number of double-difference observations actually
      processed for each observation file and each linear combination.
      RECOMMENDED VALUE: NO

    AMBIGUITIES FOR EACH ITERATION STEP:
      Printing of all ambiguity parameters after each iteration in the
      ambiguity resolution procedure (see {DAT4511_ MAX. NUMBER OF AMB},
      {DAT4514_ MAX. NUMBER OF AMB}). May be used to study the development
      of the fractional parts of the ambiguities when more and more
      ambiguities are resolved.
      RECOMMENDED VALUE: NO

                                                                          SS
```

```
4.5-2.2                 PARAMETER ESTIMATION: HELMERT

     Coord.system:
       COORD.SYSTEM    > LOCAL      <     (LOCAL or GEOCENTRIC)

     Parameters:
       ROTATION X-AXIS     > YES <        (YES or NO)
       ROTATION Y-AXIS     > YES <        (YES or NO)
       ROTATION Z-AXIS     > YES <        (YES or NO)
       SCALE FACTOR        > YES <        (YES or NO)
```

```
4.5-2.2               PARAMETER ESTIMATION: HELMERT                 HELP

     Coord.system:

       COORD.SYSTEM:
         Either "LOCAL" or "GEOCENTRIC". Specifies the coordinate system
         to be used for a Helmert transformation between the a priori
         coordinate set {DAT45___ COORDINATES} and the resulting coordinate
         set of the GPSEST run.
         RECOMMENDED VALUE: LOCAL

     Parameters:

       ROTATION X-AXIS:
       ROTATION Y-AXIS:
       ROTATION Z-AXIS:
         3 rotations around the X, Y, and Z axes.
         RECOMMENDED VALUE: YES

       SCALE FACTOR:
         RECOMMENDED VALUE: YES
```

```
   Additional Remarks:
     3 shifts along the X, Y, and Z axes are computed in any case.
     A Helmert transformation may also be performed outside the GPSEST
     program using menu 5.4.2.
                                                                  SS
```

```
4.5-2.3                 PARAMETER ESTIMATION: ORBITS

 Orbital Elements:                               (a priori sigmas)
   SEMI MAJOR AXIS      > YES <  (YES,NO)       > 0.000     <   m
   ECCENTRICITY         > YES <  (YES,NO)       > 0.0000000 <
   INCLINATION          > YES <  (YES,NO)       > 0.0000    <   arc sec
   ASCENDING NODE       > YES <  (YES,NO)       > 0.0000    <   arc sec
   PERIGEE              > YES <  (YES,NO)       > 0.0000    <   arc sec
   ARG. OF LATITUDE     > YES <  (YES,NO)       > 0.0000    <   arc sec

 Dynamical Parameters:                           (a priori sigmas)
   D0 estimation (P0)   > YES <  (YES, NO)      > 0.0D-09   <   m/s**2
   Y0 estimation (P2)   > YES <  (YES, NO)      > 0.0D-09   <   m/s**2
   X0 estimation        > NO  <  (YES, NO)      > 1.0D-09   <   m/s**2

 Periodic Dynamical Parameters:                  (a priori sigmas)
   Periodic D0 terms    > NO  <  (YES, NO)      > 1.0D-09   <   m/s**2
   Periodic Y0 terms    > NO  <  (YES, NO)      > 1.0D-09   <   m/s**2
   Periodic X0 terms    > NO  <  (YES, NO)      > 1.0D-09   <   m/s**s

 Stochastic Parameters: > YES <  (YES,NO)
```

```
4.5-2.3                PARAMETER ESTIMATION: ORBITS                HELP

 Orbital Elements:

   SEMI MAJOR AXIS:
     The semimajor axis of the orbit which defines the size of the orbit.
     RECOMMENDED VALUE: YES , a priori sigma 0.000

   ECCENTRICITY:
     The numerical eccentricity which describes the shape of the orbit.
     RECOMMENDED VALUE: YES , a priori sigma 0.000

   INCLINATION:
     The inclination of the orbital plane with respect to the equatorial
     plane.
     RECOMMENDED VALUE: YES , a priori sigma 0.000

   ASCENDING NODE:
     The right ascension of the ascending node, the angle between the
     direction to the vernal equinox and the intersection line of the
     satellite's orbital plane with the equatorial plane.
     RECOMMENDED VALUE: YES , a priori sigma 0.000

   PERIGEE:
     The argument of perigee, the angle between the ascending node and the
     perigee.
     RECOMMENDED VALUE: YES , a priori sigma 0.000

   ARG. OF LATITUDE:
     The argument of latitude, the angle between the ascending node and
     the position of the satellite at a reference epoch.
     RECOMMENDED VALUE: YES , a priori sigma 0.000

 Dynamical Parameters:

   D0 estimation (P0):
     The direct solar radiation pressure.
     RECOMMENDED VALUE: YES , a priori sigma 0.000
```

```
      Y0 estimation (P2):
        The so-called "y-bias" in the direction of the satellite's solar
        panel axis.
        RECOMMENDED VALUE: YES , a priori sigma 0.000

      X0 estimation:
        An acceleration perpendicular to the directions of "P0" and "P2".
        RECOMMENDED VALUE: NO

    Periodic Dynamical Parameters:

      Periodic D0 terms:
      Periodic Y0 terms:
      Periodic X0 terms:
        Periodic radiation pressure terms which are represented by harmonic
        functions of the argument of latitude for the satellite considered
        (see {DAT332__} to get more information).
        RECOMMENDED VALUE: NO

    Stochastic Parameters:
      To set up so-called pseudo-stochastic orbit parameters (in addition to
      the parameters above) enter "YES". These pseudo-stochastic pulses are
      velocity changes at times and in directions to be specified by the
      user in the next panel (see {DAT45231}).
      RECOMMENDED VALUE: YES

                                                                          SS
```

```
4.5-2.3.1 |          PARAMETER ESTIMATION: STOCHASTIC ORBIT PARAMETERS

 Default values:
    Force Types (max. 3 types allowed):           A-priori Sigma

      (1)  RADIAL                                  > 1.D-6    <
      (2)  PERPENDICULAR TO (1), IN ORBIT PLANE    > 1.D-5    <
      (3)  NORMAL TO ORBIT PLANE                   > 1.D-9    <  (0 or blank:
      (4)  DIRECTION TO THE SUN                    >          <   don't take)
      (5)  Y-DIRECTION IN SATELLITE FRAME          >          <
      (6)  X-DIRECTION IN SATELLITE FRAME          >          <

    Number of sets per day:                           > 2  <

 List of Satellites (prn numbers, 99(=ALL), 98(=ECL), 97(=ECLspec)):
     (blank field = take default values)

   GROUP       #PAR       SIGMA1           SIGMA2           SIGMA3

   > 99 <     >    <     >          <     >          <     >          <
```

```
4.5-2.3.1 |     PARAMETER ESTIMATION: STOCHASTIC ORBIT PARAMETERS     | HELP

 Default values:

    Force Types (max. 3 types allowed):

      Here you may select three force types to estimate pseudo-stochastic
      pulses for predetermined directions by entering any a priori sigma in
      the corresponding fields. If you want to set up the parameters (e.g.
      for later use in program ADDNEQ) but not estimate them you should use
      an a priori sigma of 1.E-9.

      (1)  RADIAL:
        RECOMMENDED VALUE: 1.E-6 m/s**2

      (2)  PERPENDICULAR TO (1), IN ORBIT PLANE:
        RECOMMENDED VALUE: 1.E-5 m/s**2

      (3)  NORMAL TO ORBIT PLANE:
        RECOMMENDED VALUE: 1.E-9 m/s**2
```

```
      (4)  DIRECTION TO THE SUN:
        RECOMMENDED VALUE: blank

      (5)  Y-DIRECTION IN SATELLITE FRAME:
        RECOMMENDED VALUE: blank

      (6)  X-DIRECTION IN SATELLITE FRAME:
        RECOMMENDED VALUE: blank

    Number of sets per day:
      The number of sets of pseudo-stochastic orbit parameters to be set up
      per 24 hours may be entered here. If you enter e.g. "2", parameter sets
      would in principle be set up at 00 UT, 12 UT, 24 UT, etc. For a 1-day
      arc the sets at 00 UT and 24 UT are not set up (the set at 00 UT is
      fully correlated with the orbital elements at the beginning of the arc
      and 24 UT is the end of the arc. Pulses at the day boundaries may
      later be set up in ADDNEQ, if you want to combine 1-day arcs into n-day
      arcs.
      RECOMMENDED VALUE: 2

List of Satellites (prn numbers, 99(=ALL), 98(=ECL), 97(=ECLspec)):

  Here you may specify satellite-specific requests concerning the handling
  of pseudo-stochastic pulses.

  GROUP:
    Enter either a list of individual satellites, "99" for all satellites,
    or "98" for eclipsing satellites. If "97" (for eclipsing satellites) is
    specified, stochastic pulses are set up for eclipsing satellites only
    for the epochs one hour after the satellites leaving the Earth's shadow.
    RECOMMENDED VALUE: 99

  #PAR, SIGMA1, SIGMA2, SIGMA3:
    Either value or blank to take the values defined in the previous
    options.
    RECOMMENDED VALUE: blank

  EXAMPLE:

List of Satellites (prn numbers, 99(=ALL), 98(=ECL), 97(=ECLspec)):
    (blank field = take default values)

  GROUP      #PAR       SIGMA1          SIGMA2          SIGMA3

  > 99 <     >    <     >         <     >         <     >         <

                                                                      SS
```

```
4.5-2.4 |                PARAMETER ESTIMATION: SPECIAL REQUESTS

  Special Requests:

    A PRIORI SIGMAS FOR SITE COORDINATES       > NO   <   (YES.. NO)

    SITE-SPECIFIC TROPOSPHERE PARAMETERS       > YES  <   (YES.. NO)
    STOCHASTIC IONOSPHERE PARAMETERS           > NO   <   (YES.. NO)
    GLOBAL IONOSPHERE MODEL PARAMETERS         > NO   <   (COE.. HGT.. NO)
    EARTH ROTATION PARAMETERS                  > NO   <   (YES.. NO)
    COORDINATES OF CENTER OF MASS              > NO   <   (YES.. NO, ASIS)
    SATELLITE ANTENNA OFFSETS                  > NO   <   (YES.. NO)
    RECEIVER CLOCK ERRORS                      > NO   <   (YES.. NO)

    PARAMETER PRE-ELIMINATION                  > NO   <   (YES.. NO, ASIS)

    SATELLITE-SPECIFIC A PRIORI SIGMAS         > NO   <   (YES.. NO)
```

```
4.5-2.4 |            PARAMETER ESTIMATION: SPECIAL REQUESTS             | HELP
```

```
Special Requests:

  A PRIORI SIGMAS FOR SITE COORDINATES:
    To specify a priori sigmas for site coordinates is recommended in
    particular if "NONE" is entered in {DAT451__.PAN STATION}, e.g. when
    producing solutions to be combined afterwards in the program ADDNEQ.
    When normal equations are saved, site coordinates should never be
    fixed but only constrained using this option here (constraints may
    later be removed/changed in ADDNEQ, but "fixed" is fixed for ever).
    RECOMMENDED VALUE: NO

  SITE-SPECIFIC TROPOSPHERE PARAMETERS:
    To set up site-specific troposphere parameters enter "YES". Tropo-
    sphere parameters should always be estimated if the session is
    longer than about 1 hour. Troposphere parameters should not be
    estimated for rapid-static data or if L4 or the Melbourne/Wuebbena
    linear combination is processed.
    RECOMMENDED VALUE: YES

  STOCHASTIC IONOSPHERE PARAMETERS:
    To set up stochastic ionosphere parameters is necessary when resolving
    ambiguity with the "QIF" strategy (see {DAT451__ QIF}).
    In principle this parameter type allows - by varying the a priori
    constraints - to continuously switch between a pure "L1&L2" solution
    and an ionosphere-free "L3" solution.
    RECOMMENDED VALUE: NO

  GLOBAL IONOSPHERE MODEL PARAMETERS:
    To set up global/regional ionosphere model parameters enter "COE".
    If you specify "HGT", the ionosphere single layer height is set up as
    as additional parameter. In this case an a priori ionosphere model
    has to be introduced in {DAT45___.PAN IONOSP. MODELS}.
    RECOMMENDED VALUE: NO

  EARTH ROTATION PARAMETERS:
    To set up earth orientation parameters like X-pole, Y-pole, UT1-UTC
    (length of day) and nutation in longitude (delta epsilon) and in
    obliquity (delta psi).
    RECOMMENDED VALUE: NO

  COORDINATES OF CENTER OF MASS:
    To set up coordinates of the Earth's center of mass enter "YES" or
    "ASIS".
    RECOMMENDED VALUE: NO

  SATELLITE ANTENNA OFFSETS:
    To set up satellite antenna offsets.
    RECOMMENDED VALUE: NO

  RECEIVER CLOCK ERRORS:
    To set up site-specific receiver clock parameters. Used for test
    purposes only.
    RECOMMENDED VALUE: NO

  PARAMETER PRE-ELIMINATION:
    To request parameter pre-elimination (see {DAT45248}) enter "YES" or
    "ASIS".
    RECOMMENDED VALUE: YES

  SATELLITE-SPECIFIC A PRIORI SIGMAS:
    To specify satellite-specific weights for the observations (see
    {DAT45245}) enter "YES". The accuracy codes given in the precise orbit
    could be used to assign a reasonable a priori sigma to each
    satellite.
    RECOMMENDED VALUE: NO

Additional Remark:

  There are some options in this panel where you may enter "ASIS".
  Please note that by entering "ASIS" the values specified last time -
  still present in the panel - will automatically be used without
  displaying the panel to you. If you are not sure what values you
  entered last time, you better say "YES" to verify the panel.

                                                                      SS
```

```
4.5-2.4.0 | PARAMETER ESTIMATION: SITE-SPECIFIC TROPOSPHERE PARAMETERS

  General Apriori Sigma:                 Special Station Sigma: (0.0: NO EST.)
    ABSOLUTE    > 0.10   <  m              ABSOLUTE     > 0.0000 <  m
    RELATIVE    > 5.00   <  m              RELATIVE     > 0.0000 <  m

  Special Station Selection:
    STATIONS    > NONE            <      (blank for selection list, NONE,
                                          SPECIAL_FILE.. $FIRST, $LAST)
  Set-up of Parameters:
    INTERPRET NEXT VALUE AS    > NUM <       (NUM: num/sess; MIN: minutes)
    # PAR/SESS OR PAR INTERVAL > 6   <       (num/sess or minutes)

    MAPPING FUNCTION           > COSZ     <  (COSZ or HOPFIELD)
```

```
4.5-2.4.0 | PARAMETER ESTIMATION: SITE-SPECIFIC TROPOSPHERE PARAMETERS | HELP

  General Apriori Sigma:

    ABSOLUTE:
      Here you may specify "absolute" a priori constraints on the values of
      the tropospheric zenith path delay parameters (with respect to the a
      priori model specified in {DAT452__.PAN TROPOSPH. MODEL}. If you
      enter "0.0", no absolute sigmas will be applied.
      Please note that too strong "absolute" constraining of troposphere
      parameters can cause significant scale biases (on long baselines).
      RECOMMENDED VALUE: 1.0 m

    RELATIVE:
      In addition you may specify so-called "relative" constraints on the
      differences between consecutive tropospheric parameters referring to
      the same station to model/limit the variation of tropospheric
      parameters in time.
      RECOMMENDED VALUE: 5.0 m

  Special Station Sigma:

    ABSOLUTE:
    RELATIVE:
      These two values - with exactly the same meaning as described above -
      are applied for all "special" stations specified just below in the
      field "STATIONS". Enter "0.0" to easily exclude a selection of
      stations from the troposphere estimation.
      For a local network it is not possible to estimate troposphere zenith
      delays for all sites of the network because of the high correlations
      between these parameters. In this case only N-1 troposphere
      parameters should be set up for N sites or the troposphere parameter
      of one site should be constrained.
      RECOMMENDED VALUE: 0.0 m (no estimation)

  Special Station Selection:

    STATIONS:
      blank:
        To get a selection list of all stations involved.
      SPECIAL_FILE:
        You may create a file to define site-specific requests concerning
        the troposphere estimation. See {DAT4516_ TROPOSPHERE SIGMAS} to
        get more information.
      $FIRST:
        To select the first station.
      $SECOND:
        To select the second station.
      $LAST:
        To select the last station involved.
      RECOMMENDED VALUE: blank

  Set-up of Parameters:

    INTERPRET NEXT VALUE AS:
```

```
      Select either "NUM" to estimate n troposphere parameters per session
      or "MIN" to estimate one parameter per n minutes, where n has to be
      specified in "# PAR/SESS OR PAR INTERVAL" below.
      RECOMMENDED VALUE: NUM

    # PAR/SESS OR PAR INTERVAL:
      With this value you may control the total number of troposphere
      parameters to be estimated (see "INTERPRET NEXT VALUE AS" above).
      RECOMMENDED VALUE: 6-12 (for 24-hour sessions)

    MAPPING FUNCTION:
      Mapping function used for the computation of the partial derivatives
      of the troposphere zenith delay parameters (not for the a priori
      troposphere model). Use either "COSZ" or "HOPFIELD".
      RECOMMENDED VALUE: COSZ

                                                                        SS
```

```
4.5-2.4.1 | PARAMETER ESTIMATION: SITE-SPECIFIC RECEIVER CLOCK OFFSET | HELP

   Site-Specific Receiver Clock Offsets:

     This panel will be displayed for each station involved.

     ESTIMATE CLOCK OFFSET:
       Type either "YES" to set up a clock offset parameter for the current
       station or "NO" to skip the station.
       RECOMMENDED VALUE: YES

     EXAMPLE:

       STATION NAME :     ZIMM                   STATION NUMBER :   100

       ESTIMATE CLOCK OFFSET  :      > YES <      (YES or NO)

                FROM                           TO                  SIGMA
       yy mm dd      hh mm ss        yy mm dd      hh mm ss          ms

     > 95 11 04 <  > 00 00 00 <    > 95 11 04 <  > 24 00 00 <    > 0.000 <
                                                                        SS
```

```
4.5-2.4.2 | PARAMETER ESTIMATION: SITE-SPECIFIC TROPOSPHERE PARAMETERS | HELP

   Site-Specific Troposphere Parameters:

     This panel will be displayed for each station involved.

     TROPOSPHERE PARAMETERS:
       Type either "YES" to set up troposphere parameters as specified below
       for the current station or "NO" to skip the station (no troposphere
       parameters are then estimated for this station). For short baselines
       we recommend to estimate only one set of troposphere parameters per
       baseline or N-1 troposphere delays for N sites.
       RECOMMENDED VALUE: YES

     CONTINUE WITH NO INTERACTION:
       If you want to continue without displaying the corresponding panels
       for the other stations enter "YES" here.
       RECOMMENDED VALUE: NO

     You might in principle even change the time intervals and absolute and
     relative sigmas for each individual request displayed to you in the
     panel, but usually this should not be necessary and is not recommended.

     EXAMPLE:

       STATION NAME :     ZIMM                   STATION NUMBER :   100
```

```
    TROPOSPHERE PARAMETERS :              > YES <      (YES or NO)
    CONTINUE WITH NO INTERACTION :        > NO  <      (YES or NO)

           FROM                        TO             ABS/REL     SIGMA
    yy mm dd  hh mm ss       yy mm dd  hh mm ss         A/R         m

  > 95 11 04  00 00 00 <   > 94 11 04  06 00 00 <     > A <    > 0.1000 <
  > 95 11 04  06 00 00 <   > 94 11 04  12 00 00 <     > R <    > 5.0000 <
  > 95 11 04  12 00 00 <   > 94 11 04  18 00 00 <     > R <    > 5.0000 <
  > 95 11 04  18 00 00 <   > 94 11 04  24 00 00 <     > R <    > 5.0000 <

                                                                          SS
```

```
4.5-2.4.3 | PARAMETER ESTIMATION:  A PRIORI SIGMAS FOR SITE COORDINATES | HELP

 A Priori Sigmas for Site Coordinates:

    SIGMA(N), SIGMA(E), SIGMA(H):
      It is allowed to change individual sigma values. E.g. you may define
      different constraints on the horizontal (N, E) and the vertical (H)
      components, respectively. All stations without a priori sigmas will
      be removed from the panel.

                                                                          SS
```

```
4.5-2.4.4 |           PARAMETER ESTIMATION:  EARTH ROTATION PARAMETERS

   Model:
     TOTAL NUMBER OF PARAMETER SETS          > 1   <

   Earth Rotation (ERP) and Nutation Parameters (NUT):
                 # param./set (0-4)  default a priori sigma
     X-POLE            > 2 <             >       <         (mas)
     Y-POLE            > 2 <             >       <         (mas)
     UT1-UTC           > 2 <           >          <        (msec)
     DELTA EPSILON     > 0 <             >       <         (mas)
     DELTA PSI         > 0 <             >       <         (mas)

     CONTINUITY BETWEEN SETS             > BOTH <  (NO, ERP, NUT, BOTH)
     CONSTRAIN DRIFTS TO ZERO            > NUT  <  (NO, ERP, NUT, BOTH)

   # of Values per Set Stored in Files:
     BERNESE POLE FILE      > 3  <       IERS POLE FILE      > 3  <
```

```
4.5-2.4.4 |      PARAMETER ESTIMATION:  EARTH ROTATION PARAMETERS      | HELP

   Model:

     TOTAL NUMBER OF PARAMETER SETS:
       Here you may enter the number of parameter sets per session to be
       estimated.

   Earth Rotation (ERP) and Nutation Parameters (NUT):

     # Param./Set (0-4):

     The number N of polynomial coefficients set up to describe the
     ERP parameter. The degree of the polynomial estimated is then N-1.
     A value of 1 means, that just an offset is estimated. With a value
     of 2 you determine an offset and a drift. No parameters are set up
     if "0" is specified.

     X-POLE:
```

```
  Y-POLE:
    RECOMMENDED VALUE: 2

  UT1-UTC:
    RECOMMENDED VALUE: 2

  DELTA EPSILON:
  DELTA PSI:
    RECOMMENDED VALUE: 0

  Default A Priori Sigma:

  A priori sigma used to constrain the zero-degree polynomial
  coefficients to the a priori models. No sigmas are used if "0.0" is
  specified.

  X-POLE:
  Y-POLE:
    RECOMMENDED VALUE: 0.0000 mas

  UT1-UTC:
    The first estimated offset in UT1-UTC is always heavily
    constrained automatically (because of the one-to-one correlations
    between the UT1-UTC offset and the orbital elements.
    RECOMMENDED VALUE: 0.0000000 msec

  DELTA EPSILON:
  DELTA PSI:
    RECOMMENDED VALUE: 0.0000 mas

  CONTINUITY BETWEEN SETS:
    To enforce continuity at the polynomial boundaries between
    subsequent sets.
    NO:
      Neither "ERP" nor "NUT" parameters.
    ERP:
      "ERP" parameters only (X-pole, Y-pole, and UT1-UTC).
    NUT:
      "NUT" parameters only (delta epsilon and delta psi).
    BOTH:
      "ERP" and "NUT" parameters.
    RECOMMENDED VALUE: ERP

  CONSTRAIN DRIFTS TO ZERO:
    To constrain first-degree polynomial coefficients to zero.
    RECOMMENDED VALUE: NUT, unless nutation parameters are estimated.


# of Values per Set Stored in Files:

  The number of records per parameter set stored in the pole files may
  be specified here. The estimated polynomials are evaluated at n
  equally spaced epochs, where n should be odd.

  BERNESE POLE FILE:
    Internal Bernese pole format.
    RECOMMENDED VALUE: 3

  IERS POLE FILE:
    Official pole format used by IERS and IGS.
    RECOMMENDED VALUE: 3

                                                                    SS
```

```
4.5-2.4.4 | PARAMETER ESTIMATION: EARTH ROTATION PARAMETERS (XP, YP, DT |  HELP
```

```
Earth Rotation Parameters "XP", "YP", and "DT":

  The first "DT" parameter (UT1-UTC)) is automatically constrained with
  a sigma of .0000001 msec. Note that here you may control the
  constraining of the zero-degree polynomial coefficients only.

  EXAMPLE:
```

```
      FROM                    TO                   SIG XP    SIG YP    SIG DT
 yy mm dd hh mm ss     yy mm dd hh mm ss      milli arc sec     milli sec
                                              *.****    *.****    .*******
> 94 11 03 00 00 00 < > 94 11 03 24 00 00 < > 0.0000 <> 0.0000 <> .0000001 <
> 94 11 04 00 00 00 < > 94 11 04 24 00 00 < > 0.0000 <> 0.0000 <> .0000000 <
> 94 11 05 00 00 00 < > 94 11 05 24 00 00 < > 0.0000 <> 0.0000 <> .0000000 <

                                                                          SS
```

```
4.5-2.4.A | PARAMETER ESTIMATION: EARTH ROTATION PARAMETERS (DEPS,DPSI) | HELP

 Nutation Parameters "DEPS" and "DPSI":

   The first set of nutation parameters is automatically constrained with
   a sigma of 0.0001 mas. Note that here you may control the
   constraining of the zero-degree polynomial coefficients only.

   EXAMPLE:

      FROM                    TO                     SIG EPS        SIG PSI
 yy mm dd hh mm ss     yy mm dd hh mm ss     milli arc sec    milli arc sec
                                                 *.****           *.****
 95 11 03 00 00 00     95 11 03 24 00 00      > 0.0001 <       > 0.0001 <
 95 11 04 00 00 00     95 11 04 24 00 00      > 0.0000 <       > 0.0000 <
 95 11 05 00 00 00     95 11 05 24 00 00      > 0.0000 <       > 0.0000 <

                                                                          SS
```

```
4.5-2.4.5 |      PARAMETER ESTIMATION: SATELLITE-SPECIFIC A PRIORI SIGMAS

 SATELLITE           FROM                      TO               SIGMA
    prn        yy mm dd hh mm ss       yy mm dd hh mm ss        meter

  >    <      >                   <   >                   <   >        <
```

```
4.5-2.4.5 | PARAMETER ESTIMATION: SATELLITE-SPECIFIC A PRIORI SIGMAS | HELP

 Satellite-Specific A Priori Sigmas:

   Here you may specify satellite-specific a priori sigmas for the zero
   difference phase observable. E.g. if you set the a priori sigma to
   0.02 meters for satellite 16, the observations of this satellite will
   have a weight 100 times smaller than the other observations assuming
   that you set the general observation sigma to 0.002 meters (see
   {DAT452__.PAN A PRIORI SIGMA}).

   EXAMPLE:

 SATELLITE           FROM                      TO               SIGMA
    prn        yy mm dd hh mm ss       yy mm dd hh mm ss        meter

  > 16 <      > 95 11 04 00 00 00 <   > 95 11 04 24 00 00 <   >  0.02   <
                                                                          SS
```

```
4.5-2.4.6 |         PARAMETER ESTIMATION: COORDINATES OF CENTER OF MASS

 Coordinates of Center of Mass:
```

```
                  Estimate            A Priori Sigma (m)

  X-COMPONENT      > YES < (YES, NO)      > 0.0001   <
  Y-COMPONENT      > YES < (YES, NO)      > 0.0001   <
  Z-COMPONENT      > YES < (YES, NO)      > 0.0001   <
```

```
4.5-2.4.6    PARAMETER ESTIMATION: COORDINATES OF CENTER OF MASS      HELP

 Coordinates of Center of Mass:

  Here you may specify component-specific requests concerning the
  estimation of the Earth's center of mass.
  RECOMMENDED VALUES:

                  Estimate            A Priori Sigma (m)

  X-COMPONENT:     > YES <                > 0.0000  <
  Y-COMPONENT:     > YES <                > 0.0000  <
  Z-COMPONENT:     > YES <                > 0.0000  <

                                                                        SS
```

```
4.5-2.4.7    PARAMETER ESTIMATION: STOCHASTIC IONOSPHERE PARAMETERS

 Stochastic Ionosphere Parameters:

  EPOCH-WISE PRE-ELIMINATION                          > YES <   (YES,NO)
  ELIMINATION OF REFERENCE IONOSPHERE PARAMETERS      > YES <   (YES,NO)

  ABSOLUTE A PRIORI SIGMA ON SINGLE DIFFERENCE LEVEL  > 0.25   < m
  RELATIVE A PRIORI SIGMA OF IONOSPHERIC RANDOM WALK  > 0.00   < m/min**1/2
```

```
4.5-2.4.7   PARAMETER ESTIMATION: STOCHASTIC IONOSPHERE PARAMETERS    HELP

 Stochastic Ionosphere Parameters:

  EPOCH-WISE PRE-ELIMINATION:
    Enter "YES" to pre-eliminate the stochastic ionosphere parameters
    epoch by epoch. This option is also given in the panel concerning the
    parameter pre-elimination (see {DAT45248 EP}). Enter "NO" to get the
    estimates.
    RECOMMENDED VALUE: YES

  ELIMINATION OF REFERENCE IONOSPHERE PARAMETERS:
    With "YES" the stochastic ionosphere parameters referring to the
    satellite observed nearest to the zenith are eliminated, i.e. you
    estimate parameters which represent the ionospheric correction on the
    double-difference level. To estimate the ionosphere parameters on the
    single difference level enter "NO".
    RECOMMENDED VALUE: YES

  ABSOLUTE A PRIORI SIGMA ON SINGLE DIFFERENCE LEVEL:
    In the ambiguity-unresolved case you have to specify absolute a priori
    weights as opposed to the ambiguity-resolved case where you may go
    without (by entering "0.00").
    RECOMMENDED VALUE: 0.25 m

  RELATIVE A PRIORI SIGMA OF IONOSPHERIC RANDOM WALK:
    You may specify relative a priori constraints between consecutive
    stochastic ionosphere parameters of the same satellite to model the
    correlation of the ionospheric signal in time. This option may be used
```

```
      only if you do not eliminate reference ionosphere parameters.
      RECOMMENDED VALUE: 0.00 m/min**1/2 (no sigma)

                                                                   SS
```

```
4.5-2.4.8                     PARAMETER PRE-ELIMINATION

   Parameters to be Pre-Eliminated: NO= No Pre-Elimination
                                    BI= Before Inversion of Normal Eq. System
                                    AI= After  Inversion of Normal Eq. System
                                    EP= After Each Epoch

     STATION COORD.    > NO <     SAT. ANT.OFF      > NO <   (NO, BI, AI, EP)
     RECEIVER CLOCKS   > NO <     EARTH POTENTIAL   > NO <   (NO, BI, AI, EP)
     ORBIT ELEMENTS    > NO <     HILL RESONANCES   > NO <   (NO, BI, AI, EP)
     AMBIGUITIES       > NO <     EARTH ALBEDO      > NO <   (NO, BI, AI, EP)
     REC.HEIGHT.CALIB. > NO <     CENTER OF MASS    > NO <   (NO, BI, AI, EP)
     SITE TROPOSPHERE  > NO <     DIFF. IONOSPHERE  > NO <   (NO, BI, AI, EP)
     LOCAL IONOSPHERE  > NO <     PHASE CENTER VAR. > NO <   (NO, BI, AI, EP)
     GM VALUE          > NO <     GLOBAL IONOSPHERE > NO <   (NO, BI, AI, EP)
     LOCAL TROPOSPHERE > NO <     ---               > NO <   (NO, BI, AI, EP)
     EARTH ROTATION    > NO <     KIN. COORDINATES  > NO <   (NO, BI, AI, EP)
     STOCH. ORBIT      > NO <                                (NO, BI, AI, EP)
```

```
4.5-2.4.8                  PARAMETER PRE-ELIMINATION                    HELP

   Parameters to be Pre-Eliminated:

     NO:
       Parameters are not pre-eliminated.
     BI:
       Parameters are pre-eliminated before the inversion of the complete
       normal equation matrix, i.e. they are not contained in the solution
       vector and thus their estimates are not available for the user.
       Please note that all pre-eliminated parameters are internally included
       in the least-squares adjustment scheme.
     AI:
       Parameters are pre-eliminated after the inversion of the full normal
       equation matrix. This option is useful, if you want to save a reduced
       normal equation system and still have the possibility to verify the
       estimates of the pre-eliminated parameters in the program output.
     EP:
       Parameters are pre-eliminated epoch by epoch. This strategy may only
       be used for epoch-specific parameters like "DIFF. IONOSPHERE" and
       "KIN. COORDINATES".

   Additional Remarks:

    -Please note that, if one or more parameter types are pre-eliminated at
     any stage, it is no longer possible to save residuals in a residual file
     (see {DAT450__.PAN RESIDUALS}).
    -In case of normal equation storing: Use option: Ambiguities AI or BI
                                         if troposphere parameters should not
                                         be stored in the NEQs:
                                         Use option: Troposphere AI

     RECOMMENDED VALUE: NO
                                                                          SS
```

```
4.5-2.4.9          PARAMETER ESTIMATION: SATELLITE ANTENNA OFFSETS

   Satellite Antenna Offsets:
```

```
   Component in Satellite        Estimate
   Coordinate System

   X-COMPONENT                   > YES <          (YES, NO)
   Y-COMPONENT                   > YES <          (YES, NO)
   Z-COMPONENT                   > YES <          (YES, NO)
```

```
4.5-2.4.9 | PARAMETER ESTIMATION: SATELLITE ANTENNA OFFSETS | HELP

 Satellite Antenna Offsets:

   Here you may specify component-specific requests concerning the
   estimation of satellite antenna offsets.
   RECOMMENDED VALUES:

   Component in Satellite        Estimate
   Coordinate System

   X-COMPONENT                   > YES <
   Y-COMPONENT                   > YES <
   Z-COMPONENT                   > YES <
                                                                    SS
```

```
4.5-2.4.B | PARAMETER ESTIMATION: A PRIORI SIGMAS: STATIONS AND DEFAULT SIGMA

  Station Selection:
     STATIONS    >                  <  (blank for selection list, SELECTED,
                                        SPECIAL_FILE.., $FIRST, $LAST)
  Default Sigma per Coordinate:
     SIGMA              > 0.0001  <    (meters)
```

```
4.5-2.4.B | PARAMETER ESTIMATION: A PRIORI SIGMAS: STATIONS AND DEFAULT | HELP

  Station Selection:

     STATIONS:
       blank:
         To get a selection list of all stations involved.
       SELECTED:
         To use the selection file of the previous run.
       SPECIAL_FILE:
         Stations which are listed in the special file with a priori
         constraints for each coordinate will be constrained to the a
         priori coordinates applying the sigmas specified. An example is
         shown in {X:\INX\EXAMPLE.FIX}. The extension of the corresponding
         file name can be found in {DAT034__.PAN SPECIAL FIXED STAT FILE}.
         This station file may also be used to fix station coordinates on
         their a priori values (see {DAT4515_}).
       $FIRST:
         To select the first station.
       $SECOND:
         To select the second station.
       $LAST:
         To select the last station involved.
       RECOMMENDED VALUE: blank

  Default Sigma per Coordinate:

     SIGMA:
       This value is used in the next panel for all stations selected, but
       may be changed on a station by station basis later on (see
```

```
      {DAT45243}).
      RECOMMENDED VALUE: 0.0001 meters (to "fix" coordinates)

                                                                SS
```

```
4.5-2.4.C      PARAMETER ESTIMATION: GLOBAL IONOSPHERE MODEL PARAMETERS

   Number of Ionosphere Models and Coefficients:
     NUMBER OF COEFFICIENT SETS PER SESSION  >  1 <
     MAXIMUM DEGREE OF SPHERICAL HARMONICS   >  8 <
     MAXIMUM ORDER  OF SPHERICAL HARMONICS   >  8 <

   Modeling Characteristics:
     TIME-DEPENDENCY             > STATIC  <      (STATIC or DYNAMIC)
     SUN-FIXED REFERENCE FRAME   > GEOGRAPHIC  <  (GEOGRAPHIC or GEOMAGNETIC)
     LONGITUDE OF THE SUN        > MEAN <         (MEAN or TRUE)
     MAPPING FUNCTION            > COSZ <         (COSZ)

   Additional Information:
     A PRIORI HEIGHT OF SINGLE LAYER  >  400.00 <  km
     LATITUDE  OF GEOMAGNETIC POLE    >   79.00 <  degrees
     LONGITUDE OF GEOMAGNETIC POLE    >  -71.00 <  degrees
     A PRIORI SIGMA FOR COEFFICIENTS  >    0.00 <  TECU     (0: no sigma)
```

```
4.5-2.4.C  PARAMETER ESTIMATION: GLOBAL IONOSPHERE MODEL PARAMETERS    HELP

   Number of Ionosphere Models and Coefficients:

     NUMBER OF COEFFICIENT SETS PER SESSION:
       Number of global ionosphere models per session.
       RECOMMENDED VALUE: 1

     MAXIMUM DEGREE OF SPHERICAL HARMONICS:
       RECOMMENDED VALUE: 8 / 4 (for global / regional models)

     MAXIMUM ORDER  OF SPHERICAL HARMONICS:
       RECOMMENDED VALUE: 8 / 4 (for global / regional models)

   Modeling Characteristics:

     TIME-DEPENDENCY:
       STATIC:
         Each set of global ionosphere model parameters is referring to a
         time window, i.e. the TEC structure is time-independent (or static)
         in the sun-fixed reference frame (not in the earth-fixed one).
       DYNAMIC:
         As opposed to the above case each coefficient set is referring to a
         reference epoch and the TEC is modeled as one or a series of linear
         polynomials which are continuous at the boundaries between
         subsequent reference epochs, i.e. the TEC structure is
         time-dependent in the sun-fixed reference frame.
       RECOMMENDED VALUE: STATIC

     SUN-FIXED REFERENCE FRAME:
       Select either "GEOGRAPHIC" to use a sun-fixed reference frame which
       is rotating around the earth rotation axis or "GEOMAGNETIC" to use a
       reference frame which is rotating around the geomagnetic dipole axis.
       RECOMMENDED VALUE: GEOGRAPHIC

     LONGITUDE OF THE SUN:
       Use a reference frame which is co-rotating with the "MEAN" or "TRUE"
       position of the Sun.
       RECOMMENDED VALUE: MEAN

     MAPPING FUNCTION:
       COSZ:
         Standard thin-shell mapping function.
       RECOMMENDED VALUE: COSZ
```

```
Additional Information:

  A PRIORI HEIGHT OF SINGLE LAYER:
    A priori height of the single layer above the Earth's surface.
    RECOMMENDED VALUE: 400 km

  LATITUDE  OF GEOMAGNETIC POLE:
    Only used if solar-geomagnetic reference frame is requested.
    RECOMMENDED VALUE:  79 degrees

  LONGITUDE OF GEOMAGNETIC POLE:
    Only used if solar-geomagnetic reference frame is requested.
    RECOMMENDED VALUE: -71 degrees

  A PRIORI SIGMA FOR COEFFICIENTS:
    RECOMMENDED VALUE:  10 TECU (for regional models)

                                                                    SS
```

```
4.5-2.4.D            PARAMETER ESTIMATION: HEIGHT OF SINGLE LAYER

Number of Single-Layer Height Parameters:
  NUMBER OF HEIGHT PARAMETERS  > ALL  <  (one for ALL  ionosphere models,
                                          one for EACH ionosphere model)

A Priori Sigma for Height Parameters:
  A PRIORI SIGMA FOR HEIGHT PARAMETERS  >    0.00 <  km  (0: no sigma)
```

```
4.5-2.4.D         PARAMETER ESTIMATION: HEIGHT OF SINGLE LAYER          HELP

Number of Single-Layer Height Parameters:

  NUMBER OF HEIGHT PARAMETERS:
    ALL:
      Estimate one single-layer height parameter which is common for all
      global ionosphere models.
    EACH:
      Estimate individual height parameters for each ionosphere model.
    RECOMMENDED VALUE: ALL

A Priori Sigma for Height Parameters:

  A PRIORI SIGMA FOR HEIGHT PARAMETERS:
    RECOMMENDED VALUE: 0 (no sigma)

                                                                    SS
```

```
4.5-2.4.E  PARAMETER ESTIMATION: GLOBAL IONOSPHERE MODEL PARAMETERS     HELP

Model Numbers and Time Boundaries:

  Here you may add, modify, or remove lines.

                                                                    SS
```

```
  4.7                     PROCESSING: IONOSPHERE MODEL

 CAMPAIGN         >          <     (blank for selection list)
```

```
  Input Files:
    MEASUREMENT TYPE > PHASE    <     (CODE, PHASE)
    OBSERVATIONS     >          <     (blank for selection list)
    COORDINATES      >          <     (blank for selection list)
    ECCENTRICITIES   > NO       <     (NO, if not used; blank for sel.list)
    STANDARD ORBIT   >          <     (blank for selection list)

  Output Files:
    IONOSPHERE MODEL > IONTST   <     (NO, if not to be saved)
    RESIDUALS        > NO       <     (NO, if not to be saved)
```

```
 4.7                 PROCESSING: IONOSPHERE MODEL                  HELP

General Remarks:

  The purpose of the program IONEST is the estimation of local ionosphere
  models using the geometry-free (L4) linear combination of zero difference
  phase (or code) measurements. The Vertical Total Electron Content (VTEC)
  is modeled by a two-dimensional Taylor series in a sun-fixed reference
  frame.
  Ionosphere model files are mainly used in the parameter estimation program
  GPSEST (see menu 4.5) either to improve the ambiguity resolution or to
  reduce the scale factor caused by ionospheric refraction effects when
  not processing the ionosphere-free (L3) observable. The pre-processing
  program MAUPRP can handle ionosphere model files, too.
  To create more than one local ionosphere model per session, you have to
  split up the observation file(s) into sub-sessions, estimate a model per
  sub-session, and finally fit together the individual ionosphere model
  files to a common ionosphere file (see {X:\INX\EXAMPLE1.ION}).
  Note that the estimation of global (or regional) ionosphere models is
  supported by the program GPSEST (see {DAT4524_.PAN}, {DAT4524C.PAN}).
  An example is given in {X:\INX\EXAMPLE2.ION}.

  Input Files:

    MEASUREMENT TYPE:
      Either zero difference code or phase measurements may be used.
      RECOMMENDED VALUE: PHASE

    OBSERVATIONS:
      Selection of the zero difference phase (or code) file(s) to be
      processed. Several files of the same session may be processed in the
      same program run.
      RECOMMENDED VALUE: blank or wildcard

    COORDINATES:
      Selection of a coordinate file which contains all the sites you are
      processing.
      RECOMMENDED VALUE: blank or wildcard

    ECCENTRICITIES:
      Optionally a site coordinate eccentricity file may be specified
      containing local ties between markers.

    STANDARD ORBIT:
      Selection of one standard orbit file containing the information about
      the satellite positions.
      RECOMMENDED VALUE: blank or wildcard

  Output Files:

    IONOSPHERE MODEL:
      To save the estimated ionosphere model coefficients enter a file name
      here. If "NO" is specified the ionosphere model is not saved.
      RECOMMENDED VALUE: file name

    RESIDUALS:
      The zero difference L4 phase (or code) residuals are saved, if you
      enter a file name here. These residuals may be looked at using menu
      5.3.1 or 5.3.2. Residuals may also be written to the program output
      file by setting the corresponding option in the next panel
```

```
    {DAT471__ PRINT RESIDUALS}.
    RECOMMENDED VALUE: NO

                                                                  SS
```

```
4.7-1                      IONOSPHERE MODEL: INPUT

  TITLE    >                                                  <

  Preprocessing:
    PRINT MESSAGES                        > NO  <    (YES or NO)
    CARRIER FOR BREAK DETECTION           > L4  <    (L3 or L4)
    POLYNOMIAL DEGREE                     > 1   <    (0,1,2,3)
    MAX.INTERVAL FOR TEST                 > 4   <    minutes
    RMS OF ONE OBSERVATION               > 0.01  <   meters

  Processing Options:
    PRINT RESIDUALS                       > NO  <    (YES or NO)
    MIN. ELEVATION                        > 15  <    degrees
    HEIGHT OF THE LAYER                   > 400 <    kilometers
    DEGREE OF DEVELOPMENT IN LATITUDE     > 1   <
    DEGREE OF DEVELOPMENT IN HOUR ANGLE   > 2   <
    MAXIMUM DEGREE IN MIXED COEFFICIENTS  > 2   <
```

```
4.7-1                    IONOSPHERE MODEL: INPUT                   HELP

  TITLE:
    This title line will be printed as header comment in the program output
    and will be saved in all the result files specified in panel 4.7 to
    document the program run. The title should characterize the program run
    by e.g. giving the most important options used and the session.

  Preprocessing:

    PRINT MESSAGES:
      Satellite-specific information concerning the preprocessing will be
      printed into the program output, if you enter "YES" here.
      RECOMMENDED VALUE: NO

    CARRIER FOR BREAK DETECTION:
      You may use either the ionosphere-free (L3) or the geometry-free (L4)
      linear combination for the data cleaning.
      RECOMMENDED VALUE: L4

    POLYNOMIAL DEGREE:
      The same pre-processing algorithm is used as in the programs CODCHK
      and MAUPRP (see menu 4.1, {DAT411__ POLYNOMIAL DEGREE} and menu
      4.4.2, {DAT44222 POLYNOMIAL DEGREE}).
      A test is performed whether the zero difference observations can be
      represented by a low-degree polynomial over a short time span. The
      degree of the polynomial is specified here.
      RECOMMENDED VALUE: 1

    MAX.INTERVAL FOR TEST:
      Maximum time interval for the break detection algorithm should
      contain at least n+2 observation epochs (where n is the polynomial
      degree specified above (see also {DAT4422_ MAX. INTERVAL OF FIT}).
      RECOMMENDED VALUE: 4 minutes

    RMS OF ONE OBSERVATION:
      This a priori RMS error of the phase (or code) observations (see
      {DAT47___.PAN MEASUREMENT TYPE) is used for the statistical test
      in the pre-processing part.
      RECOMMENDED VALUE: 0.01 meters (for phase observations)

  Processing Options:

    PRINT RESIDUALS:
```

```
    If "YES" is entered here the L4 phase (or code) residuals are printed
    into the program output. If you would like to save the residuals in a
    special residual file, you should specify a residual output file in
    panel 4.7 (see {DAT47___.PAN RESIDUALS}).
    RECOMMENDED VALUE: NO

  MIN. ELEVATION:
    Only phase (or code) measurements above the elevation cut-off angle
    specified here will be used for the estimation of the ionosphere
    model.
    RECOMMENDED VALUE: 15 degrees

  HEIGHT OF THE LAYER:
    A priori height of the single layer above the Earth's surface.
    RECOMMENDED VALUE: 400 kilometers

  DEGREE OF DEVELOPMENT IN LATITUDE:
    Maximum degree of pure latitude terms to be set up.
    RECOMMENDED VALUE: 1

  DEGREE OF DEVELOPMENT IN HOUR ANGLE:
    Maximum degree of pure longitude terms to be set up.
    RECOMMENDED VALUE: 2

  MAXIMUM DEGREE IN MIXED COEFFICIENTS:
    Coefficients of the two-dimensional Taylor series, where the sum of
    both indices exceeds this value, will not be estimated.
    RECOMMENDED VALUE: 2

                                                                       SS
```

```
4.8.1                      ADD NORMAL EQUATION SYSTEMS

   CAMPAIGN           >          <    (blank for selection list)

 Job Identification:
   JOB CHARACTER        >   <        (blank, or characters A - Z, 0 - 9)

 Input Files:
   NORMAL EQUATIONS      >          <    (blank:  sel.list)
   UPDATE CRD.           > NO       <    (NO: not used, blank: sel.list)
   FIX ON SPEC. COORD.   > NO       <    (NO: not used, blank: sel.list)
   A PRIORI VELOC.       > NO       <    (NO: not used, blank: sel.list)
   FIX ON SPEC. VELOC.   > NO       <    (NO: not used, blank: sel.list)
   PLATE TABLE NUVEL1    > NO       <    (NO: not used, blank: sel.list)
   COV. COMPONENT INTRO  > NO       <    (NO: not used, blank: sel.list)
   PRE-DEFINED BASELINES > NO       <    (NO: not used, blank: sel.list)
   SITES FOR REPEATABIL. > NO       <    (NO: not used, blank: sel.list)
```

```
4.8.1                     ADD NORMAL EQUATION SYSTEMS                HELP

 General Remarks:

   This program is a tool to combine results achieved by sequential
   solutions with GPSEST or results already combined with ADDNEQ before.

   The input are the normal equation files, which have to be saved
   when running GPSEST (or ADDNEQ). The algorithms are in principle
   identical to those used for a combination of coordinate results taking
   into account the variance-covariance information between the
   parameters (see COMPAR program {DAT541__}).
   In contrast to the program COMPAR most of parameters saved in the NEQ
   files (not only site coordinates) can be handled by ADDNEQ such as
      - station coordinates and velocities
      - troposphere parameters
      - orbit parameters, stochastic orbit parameters
      - Earth rotation (x,y,LOD) and nutation dpsi and deps
      - center of mass
```