User's Guide SLIB3D

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User's Guide SLIB3D

SLIB3D is a postprocessor to compute the distribution of silt using the results of a TRIWAQ computation

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Contents

1 General directions for the use of SLIB3D

1.1 Background information

SLIB3D is used for the numerical simulation of three-dimensional transport, erosion and sedimentation of suspended matter in estuaries, coastal seas, rivers and harbors. The major part of the program is written in FORTRAN77. The SLIB3D system as described in this User's Guide SLIB3D only deals with SIMONA based subsystems. Up to 1992 SLIB3D consisted of approximately 25 non-SIMONA subsystems. Some of these program parts are, in a revised form and fulfilling the SIMONA programming standards, incorporated in the present SLIB3D version. This version was adapted in 2002 in order to comply with the SIMONA norms.

simulation

The system can simulate transports in geographical areas which are not rectangular and which are bounded by any combination of closed (i.e. land) and open (i.e. see) boundaries. The system accounts for several sources. Instantaneous, continuous and point sources can be used in the interior of the model grid. Line-sources at the model boundaries can be applied for boundary inflow of suspended matter. The used hydrodynamic variables like lagrangian displacements of water mass, the water levels and the velocities have to be calculated prior to the SLIB3D computation using TRIWAQ. The TRIWAQ and SLIB3D programs are coupled 'off-line' and communicate with each other through an SDS-file. There is a strong correspondence between the data structures used in TRIWAQ and SLIB3D.

physical processes

The main physical processes are:

1. horizontal movement due to advection and diffusion;
2. vertical movement due to advection, turbulence diffusion and gravity;
3. deposition and resuspension at the bottom under the influence of the local flow situation.

In the resuspension terms there may be a strong influence of short waves, which are generated by wind. This influence is incorporated in a rough way, by estimating the additional shear velocity due to wind-induced waves, at the bottom in advance. This shear velocity must be subtracted from the critical velocity for erosion and added to the critical velocity for sedimentation. This is usually no problem, because the accuracy of silt models is limited primarily by the unknown structure of the bottom layer. However, since only a time-independent additional shear velocity is implemented the program SLIB3D is currently not well suited for long-term (seasonal) simulations, or simulations with a dynamic wind forcing. This is especially the case in estuaries, large shallow lakes or in the coastal zone, but less important in harbors or rivers.

The vertical turbulence affects the vertical dispersion processes. Therefore the vertical turbulence structure is computed with TRIWAQ. The vertical diffusion coefficient ($m^2 s^{-1}$) of TRIWAQ is used in SLIB3D. The use of this feature is for instance very important where salt intrusion takes place (i.e. Nieuwe Waterweg to Rotterdam harbor). For calibration, the vertical diffusion coefficient can be scaled with a constant and spatially uniform factor. Flocculation has to be simulated by increasing locally the fall velocities. Hereto, various fall velocities can be specified in user-defined boxes. However, these fall velocities must be constant in time within a box.

second moment method

The numerical approach used in SLIB3D is the so-called second moment method. Since this method is a lagrangian (time-explicit) method it is closely related to the transport of particles in SIMPAR. However, instead of considering each particle as a separate entity, the masses in SLIB3D can split and joined. At the beginning of each step each 3D grid cell and each bottom cell in SLIB3D contains only one mass entity. After the execution of the advection, diffusion, deposition and resuspension substeps masses are split up and joined again in a way that each grid cell contains again only one mass entity of which the weight is stored (0^{th} moment), it's center of gravity (1^{st} moment), the width of the area that is occupied in all coordinate directions (2^{nd} moment) and the cross moment in the horizontal. The latter gives the possibility to represent masses with sub grid distributions with an oblong shape in an arbitrary horizontal direction.

The computation is carried out on the same grid as the previous TRIWAQ simulation. The method is mass conserving. When the Lagrangian dispacements are computed in a divergence free way, the first and second moments are conserved as well. The numerical accuracy in space is high which makes the method very well suited for studies (like e.g. for dredging operations or dumping of dredge spoil) where spatial detail is important. Especially sub-grid details as fronts and thin oblong patches are well reproduced, which is important in the vicinity of point sources. Also the strong concentration gradients occurring in high concentration benthic suspensions and in the transition area between suspension and fluid mud are well preserved.

lagrangian displacements

The advection step in SLIB3D depends on the flow-field computed in a TRIWAQ simulation, using the Lagrangian time-integration feature of TRIWAQ. This means that not the primary (Eulerian) results of the computed flow velocities are used, but that TRIWAQ is instructed to compute Lagrangian displacements as well. These Lagrangian displacements accumulate the total movement of "particles" over integration periods that consist of multiple TRIWAQ time steps. This integration period corresponds to the time step that is used in SLIB3D. At the beginning of each integration period in the middle of each 3D grid cell a particle is released. At the end of each period for each particle the displacement is written on the SDS-output file. Subsequently, SLIB3D uses this Lagrangian displacement for the advection of suspended matter.

some limitations

In the future, a dynamic simulation of the shear velocity due to wind-induced short waves and the interaction between silt and turbulence may be included. The latter not only affects the settling of suspended matter but also can lead to lutocline formation (and thereby even affect the motion of water). It also may become desirable to include the wave-current interaction and the wave-turbulence interaction in TRIWAQ and to export improved shear stresses to SLIB3D.

graphics

A SLIB3D simulation of a reasonable simulation period can generate large sets of numbers. In order to get an impression of the meaning of these numbers an important help function of the system is to make the computational results visible. Such graphics include maps and time histories. Maps show computations for a point in time over a part of or over the entire water body. Time history graphs show computations at one point in space for a specified time period. SLIB3D generates files that are suited for such visualization programs. At present, however, visualization tools for SLIB3D are not supported yet by the SIMONA (or KALMINA) post processing tools. A coupling with KALGUI is foreseen in the near future.

data management

Some other functions of SLIB3D can be grouped under the heading of data management. Input data are checked by the program and printed in a (future) input report for easy inspection by the user. The input report is, together with the input file used, an effective documentation of the model.

flexibility

The system is flexible in such a way that small models can be run on small computers while large models require large computers (especially for the simulation itself). The program sizes vary with the size of the model, and the model can disregard various features of the system, including water-quality computation. The program is not yet available for parallel processing; neither can it be used in combination with domain decomposition.

1.2 Introduction to the system

When the system is fully used, several steps are involved. Generally speaking the same remarks can be made as for the WAQUA system. See for an explanation sections 3.1.2. and 3.1.3. of the WAQUA users guide.

1.3 Computational method

SLIB3D grid

The grid used in SLIB3D is the same grid as used in the WAQUA/TRIWAQ program. See for the description of the grid the possibilities in the WAQUA/TRIWAQ documentation. Be aware of the fact, already said, that the user has to choose the model type as early as when running the TRIWAQ program.

SLIB3D is based on the second moment method and can be used on several computational grids: rectilinear, curvilinear and spherical. In the 'Technical Description SLIB3D' more information on the mathematical and computational method used is given. In that report also the boundary treatment is given.

1.4 Involved files

SLIB3D uses the results of a TRIWAQ computation as stored in a SIMONA DATA STORAGE (SDS) file. (See for an explanation the SIMONA PROGRAMMERS GUIDE). SLIB3D itself generates also files for post processing. In the TRIWAQ computation the use of the keys SDSOUTPUT and INTEGRATION TYPE='LAGRANGE' is mandatory since the lagrangian quantities are the basis of the transport in SLIB3D.

It is also mandatory to write maps to the SDS-file with a time-step equal to that of the lagrangian displacements. Moreover, it is mandatory to use the option 'INITIALIZE_START_POSITION' for the lagrangian displacements. If this option is not used (default in TRIWAQ is that it is not used!!), the lagrangians are not suited for Slib3d advective transport and erroneous results are obtained.

An example of the block 'SDSOUTPUT' in the TRIWAQ input file (see also WAQUA User's Guide) is given below (RESTART may be omitted):

```
SDSOUTput

  MAPS
    TFMAPs =  7140, TIMAPs = 15.0 TLMAPs=8640.0
  HISTories
    TFHISto =    0.00, TIHISto=  15.00
  RESTART
    TFREST =  7140.0, TIRest = 15.0, TLRest =  8640.0
  INTEGRATION
    TFINTEGR =  7140.0, TIINTEGR = 15.0, TLINTEGR =  8640.0
    TYPE = 'LAGRANGE'
    INITIALIZE_START_POSITION

# end sdsoutput
```

1.5 Instantaneous sources and continuous sources.

A simulation with SLIB3D can be based on instantaneous sources as well as on continuous sources. Instantaneous sources are the ones where all matter is released in one moment (for a description of such a source see the INPUT description in the next chapter); continuous sources are the ones where the release takes place during a longer time period. (See also in the INPUT description).

In SLIB3D several types of sources are possible: point sources, line sources and surface sources. In the input description the user is informed in which way these features may be used.

The position of the sources is represented by grid cell coordinates (M,N) with respect to the grid origin.

1.6 Output results

The computational results of SLIB3D are written to an SDS file. In the file the mesh of the TRIWAQ computation and hence of the SLIB3D computation and the computational results for the areas are stored. Computational results on cross-sections (i.e. sections with either the M or the N coordinate fixed, results for all layers are given) are written to two specific ASCII files: one file for the mass results of the cross-section (combined with flows in order to produce mass fluxes through the cross section), and one file for the concentrations. The names of these files are given by the user in the input file.

Note The ASCII output (mass results and concentrations) has not been checked. Therefore it may be unreliable.

At present, there are no standard tools available to visualize (or simply to read) the results of the SLIB3D SDS file.

2 Input description of SLIB3D

2.1 General information

The input is based on the SIMONA keyword structure. We refer to 'About SIMONA' in Section 1 'General Information' of the User's Guide WAQUA.

For a background of all the variables used we refer to the 'Technical Description SLIB3D'. For a theoretical background we refer to 'Numerical Modeling of transport processes in Coastal waters', by J.M. de Kok (Ph.D. Thesis University of Utrecht, 1994).

Reminder: The input file is a structured ASCII-file. From the input file only the first 120 columns are read.

Note: *If the last keyword block in the input file contains a sequential keyword, the SIMONA application independent preprocessor is not able to check the correctness of the block. This can result in incorrect processing of the input file!*

2.1.1 Conventions used

For the input definition the following conventions (see also the description in the WAQUA Users Guide) are used:

[val]	:	real value[1]
[tval]	:	time specification in the form: *day hours:minutes* (e.g. 2 21:15). Times are given relative to midnight of a reference date, starting at 0 0:00.
[ival]	:	integer value
[iseq]	:	sequence number to indicate a point, area, etc.
[text]	:	string (enclosed between quotes)
< ... >	:	repetition group
| A < | B	:	choice between A and B (A and B are mutually exclusive)
&	:	Continuation mark

In this document a part of the key words is underlined (e.g. PRINT-OUTPUT). Only the underlined characters are significant. So the user must type at least PRINT in his input, but PRINTOUT is accepted as well.

The 'Explanation' part of the description of the various sections, subsections is divided in three columns:

[1]Since all values are read in free format: integer notation (when reals are expected) will be converted to reals, so "val = 4" is identical to "val = 4.0".

KEY-WORD **E** Explanation

E can be O, M, D, S, R, X.

O means that the keyword is optional.

M means that the keyword is mandatory

D means that the keyword has a default value. When this keyword is omitted, the preprocessor will use the default value for the variable specified by means of this keyword

S means that this keyword is a sequential keyword: a keyword followed by an integer (e.g. S4). A sequential keyword can be used repeatedly

R means that the keyword may occur more than once

X exactly one of a sequence of keywords should be given

2.1.2 Data

The input data for SLIB3D is given in two files. The first file is the TRIWAQ SDS-file with the values of the hydrodynamic system. This file is a result of a TRIWAQ run. In the TRIWAQ input file it is given which data have to be written to the SDS-file. The TRIWAQ output is realized using the keywords SDSOUTPUT, MAPS and INTEGRATION (type = 'Lagrange'). Important for SLIB3D are the maps with lagrangian displacements since these are used for the calculation of the transport of suspended matter. Also water levels and velocities are used for calculation of sedimentation- and erosion processes, and of concentrations. Further, the vertical diffusion coefficients are used for vertical diffusion of suspended matter.The name of this file is indicated with the keyword TRIWAQ.

The second input file is the SLIB3D input file: this file is described extensively in sections 2.3 and 2.4.

2.1.2.1 Times

In the SLIB3D input file times and time steps are asked for.
The time step for the calculation of the transport of suspended matter is the same as the time step of the time series in the SDS-file (see key-words DTTIM and DTSLI in the next sections.)

The time t = 0.0 minutes is the time of the first written map in the SDS-file (whatever the time in the TRIWAQ run may have been). So water level at time 6000 means water level 6000 minutes after the first stored water level in the SDS-file. Times and timesteps are set with the SLIB3D keywords TFSLI, TLSLI,TFTIM and TLTIM .

TRIWAQ shifts the lagrangian integrals for displacements over $+\Delta t$, but this is corrected for by SLIB3D.

2.1.2.2 Global / Local

The erosion coefficient, the critical erosion velocity, the critical sedimentation velocity and the fall velocity are given with the keyword REALS and are valuable for the total area of the used model (these values are global values). The global values, however can be overruled with the keywords SEDAREAS and DPTHSEDAREAS for enforcing local sedimentation or erosion areas, for example an intense erosion in shallow waters. The values given with those keywords are local. They are only valuable for the, locally specified, area.

2.2 Main keywords

The input file for SLIB3D is a very simple one compared to for instance the input files for WAQUA or TRIWAQ. There are only two main keywords.

These main keywords are (M = mandatory, O=optional):

FILES	(M)
COEFFICIENTS	(M)
DECAY	(O)

These keywords, their meaning and the possibilities are described in the next sections.

2.3 FILES (mandatory)

In the 'files block' general information about the input- and output files is given. This section is mandatory.

FILES
- TRIWAQ = *[text]*
- EXPTRI = *[text]*
- RSIFIL = *[text]*
- RSOFIL = *[text]*
- TIMFIL = *[text]*
- SLOFIL = *[text]*

Explanation of the key-words

TRIWAQ=*[text]*	**M**	In *[text]* the name of the TRIWAQ (SDS) input file is given.
EXPTRI=*[text]*	**M**	In *[text]* the name of the TRIWAQ experiment is given.
RSIFIL=*[text]*	**O**	In *[text]* the name of the SLIB3D restart input file is given.
RSOFIL=*[text]*	**O**	In *[text]* the name of the SLIB3D restart output file is given.
TIMFIL=*[text]*	**O**	In *[text]* the SLIB3D cross-section file (ASCII output file) for concentrations is given.
SLOFIL=*[text]*	**O**	In *[text]* the SLIB3D cross-section file (ASCII output file) for mass and flows is given.

Notes: – Maximum length of *[text]* is: 40 characters.

– See your TRIWAQ run for the name of the TRIWAQ (SDS) input file and for the name of the experiment.

– The Restart file contains the moments at the last time-point (these are the results of the last time step) of the previous computation. The restart may be done at any time, e.g. not necesarilly at the time the data were stored.

– The ASCII output files are not checked, so they could be unreliable.

2.4 COEFFICIENTS (mandatory)

General information about the physical parameters and the time values is given in this section.

COEFFICIENTS
- INTEGERS
- REALS
- OUTAREAS
- SEDAREAS
- DTPHSEDAREAS
- PNTSRCSMBND
- PNTSRCSNBND
- INSTPNTSRCS
- CONTPNTSRCS

2.4.1 INTEGERS (mandatory)

In this section the parameters that drive the computation and that need integer values are given.

INTEGERS
- LSLI = *[ival]*

Explanation:

LSLI=*[ival]* **D** Type of output to file specified with the key-word SLOFIL
LSLI = 0 : no output.
LSLI = 1 : output as concentration.
LSLI = 2 : output as mass volumes. (moments)
Default = 1.

Note: – If the keyword SLOFIL is omitted, LSLI gets value 0.

2.4.2 REALS (mandatory)

In this section the real values are given.

REAIS
- TFIRST = *[val]*

TLAST = *[val]*
DTSLI = *[val]*
TFSLI = *[val]*
TLSLI = *[val]*
DTTIM = *[val]*
TFTIM = *[val]*
TLTIM = *[val]*
KXM = *[val]*
KXY = *[val]*
KYN = *[val]*
DZNUL = *[val]*
EROCOF = *[val]*
EROVEL = *[val]*
SEDVEL = *[val]*
GRAVAL = *[val]*

Explanation:

TFIRST=*[val]*	**M**	Start time of the simulation in elapsed minutes from the beginning of the TRIWAQ simulation output date.
TLAST=*[val]*	**M**	End time of the simulation in elapsed minutes from the beginning of the TRIWAQ simulation output date.
DTSLI=*[val]*	**O**	Time interval to write data to SLIB3D output file.
TFSLI=*[val]*	**O**	Time first to write data to SLIB3D output file.
TLSLI=*[val]*	**O**	Time last to write data to SLIB3D output file. (All times in elapsed simulation minutes)
DTTIM=*[val]*	**O**	Time interval to write time series to SLIB3D time series file.
TFTIM=*[val]*	**O**	Time first to write time series to SLIB3D time series file.
TLTIM=*[val]*	**O**	Time last to write time series to SLIB3D time series file. (All times in elapsed simulation minutes)
KXM=*[val]*	**M**	The diffusion coefficient (in m^2s^{-1}) in x-direction.
KXY=*[val]*	**M**	The diffusion coefficient (in m^2s^{-1}) in x,y-direction.
KYN=*[val]*	**M**	The diffusion coefficient (in m^2s^{-1}) in y-direction.
DZNUL=*[val]*	**M**	The coefficient for calculating the vertical diffusion (in m^2s^{-1}).
EROCOF=*[val]*	**M**	The erosion coefficient (in $kgm^{-2}s^{-1}$).
EROVEL=*[val]*	**M**	The critical erosion velocity (in ms^{-1}).
SEDVEL=*[val]*	**M**	The critical sedimentation velocity (in ms^{-1}).
GRAVAL=*[val]*	**M**	The fall velocity (in ms^{-1}).

Notes:

- When slib output is to be created (LSLI >0), the keywords DTSLI, TFSLI and TLSLI are mandatory.
- When time series are to be written, the keywords DTTIM, TFTIM and TLTIM are mandatory.
- TFIRST, TFSLI, TFTIM should not be greater than respectively TLAST, TLSLI, TLTIM.
- The values of DTTIM and DTSLI are not allowed to be smaller than the time step of the calculation. Neither are they allowed to be greater than respectively (TLTIM - TFTIM) and (TLSLI - TFSLI).
- The given values of EROCOF, EROVEL, SEDVEL and GRAVAL are global. The keywords SEDAREAS and DPTHSEDAREAS give the opportunity to enforce local values.

2.4.3 OUTAREAS (optional)

In this section the output cross-section(s) for the output of time series of discharges is given. These are the output cross-sections for the ASCII output files (TIMFIL and SLOFIL) of section 2.3.

OUTAREAS
 < AREA[iseq]:
 MFIRST = [ival],
 MLAST = [ival],
 NFIRST = [ival],
 NLAST = [ival]
 >

Notes: – Because the area is a cross section either the value of MFIRST = MLAST (along M=constant) or NFIRST = NLAST (N=constant). This is checked for by the program, and an error is given when this condition is not fulfilled.

If the keyword OUTAREAS is used, the user has to give the keyword AREA and the keywords MFIRST, MLAST, NFIRST and NLAST.

Explanation:

AREA*[iseq]*	**M**	Area sequence number.
MFIRST=*[ival]*	**M**	Number of the starting grid point of the area in the M-direction.
MLAST=*[ival]*	**M**	Number of the ending grid point of the area in the M-direction.
NFIRST=*[ival]*	**M**	Number of the starting grid point of the area in the N-direction.
NLAST=*[ival]*	**M**	Number of the ending grid point of the area in the N-direction.

2.4.4 SEDAREAS (optional)

In this section the erosion/sedimentation area for local values and the local values for erosion and sedimentation are given. For the specified area, the local values given here overrule the global values given in the keyword REALS.

SEDAREAS

< AREA [iseq]:
 MBEG = *[ival]*
 MEND = *[ival]*
 NBEG = *[ival]*
 NEND = *[ival]*
 EROCOF = *[val]*
 EROVEL = *[val]*
 SEDVEL = *[val]*
 VAL = *[val]*
>

Notes: – If the keyword SEDAREAS is used, the user has to give the keyword AREA and the keywords MBEG, MEND, NBEG, NEND, EROCF, EROVEL, SEDVEL and VAL.

Explanation:

AREA*[iseq]*	**M**	Area sequence number.
MBEG=*[ival]*	**M**	Number of the begin grid point of the area in the M-direction.
MEND=*[ival]*	**M**	Number of the end grid point of the area in the M-direction.
NBEG=*[ival]*	**M**	Number of the begin grid point of the area in the N-direction.
NEND=*[ival]*	**M**	Number of the end grid point of the area in the N-direction.
EROCOF=*[val]*	**M**	The erosion coefficient for the specified area (in $kgm^{-2}s^{-1}$).
EROVEL=*[val]*	**M**	The critical erosion velocity for the specified area (in ms^{-1}).
SEDVEL=*[val]*	**M**	The critical sedimentation velocity for the specified area (in ms^{-1}).
VAL=*[val]*	**M**	The fall velocity for the specified area (in ms^{-1}).

2.4.5 DPTHSEDAREAS (optional)

In this section the area for local values in case of depth dependent erosion and sedimentation are given. For the specified area, the local values given here overrule the global values given in the keyword REALS and the local values given in the keyword SEDAREAS, but only if the local depth is smaller than the specified value of DEPTH. If the local depth is larger than the specified value of DEPTH, then the local values for erosion and sedimentation given here are neglected.

```
DPTHSEDAREAS
    <
        AREA[iseq]:
            MBEG   = [ival]
            MEND   = [ival]
          NBEG   = [ival]
            NEND   = [ival]
          DEPTH  = [val]
            EROCOF = [val]
          EROVEL = [val]
          SEDVEL = [val]
          VAL    = [val]
    >
```

Notes: – If the keyword DPTHSEDAREAS is used, the user has to give the keyword AREA, its sequence number and the keywords MBEG, MEND, NBEG, NEND, EROCF, EROVEL, SEDVEL and VAL.

Explanation:

AREA*[iseq]*	**M**	Area sequence number.
MBEG=*[ival]*	**M**	Number of the begin grid point of the area in the M-direction.
MEND=*[ival]*	**M**	Number of the end grid point of the area in the M-direction.
NBEG=*[ival]*	**M**	Number of the begin grid point of the area in the N-direction.
NEND=*[ival]*	**M**	Number of the end grid point of the area in the N-direction.
DEPTH=*[val]*	**M**	The depth value (in m).
EROCOF=*[val]*	**M**	The erosion coefficient (in $kgm^{-2}s^{-1}$).
EROVEL=*[val]*	**M**	The critical erosion velocity (in ms^{-1}).
SEDVEL=*[val]*	**M**	The critical sedimentation velocity (in ms^{-1}).
VAL=*[val]*	**M**	The fall velocity (in ms^{-1}).

2.4.6 PNTSRCSMBND (optional)

In this section the concentration in grid cells at an open boundary line in M-direction is given. Mass (i.e. boundary concentration*cell-volume) is released uniformly for all layers. However, the mass will only enter the grid when:

a) the flow (to be precise: the lagrangian displacement of a water volume) is directed in a direction that transports water into the model domain;

b) The cell in which the mass is released is an active grid cell.

If not, mass will not be added to the simulation.

```
PNTSRCSMBND
    <
        LINE[iseq]:
            MBEG  = [ival]
          MEND  = [ival]
          NSRC  = [ival]
          CPSVAL = [val]
    >
```

Explanation:

LINE*[iseq]*	**M**	Line sequence number.
MBEG=*[ival]*	**M**	Number of the M-line where the begin grid point of the open boundary is situated on.
MEND=*[ival]*	**M**	Number of the M-line the end grid point of the open boundary is situated on.
NSRC=*[ival]*	**M**	Number of the N-line the open M boundary is situated on.
CPSVAL=*[val]*	**M**	The concentration (in kgm^{-3}).

Notes:

– The boundary of the grid is the cell just within the active grid, adjacent to the velocity point where the boundary inflow of TRIWAQ is given. i..e. at NSRC = 2 or NSRC = NMAX – 1.

– The option can also be used within the grid (2 < N < NMAX-1). Then, the flow direction which is used to determine whether mass must be released follows from the quadrant of the grid where the grid cell is.

2.4.7 PNTSRCSNBND (optional)

In this section the concentration in grid cells at an open boundary line in N-direction is given (see section 2.4.6 for futher explanations).

```
PNTSRCSNBND
```

```
<
    LINE [iseq]:
        NBEG = [ival]
        NEND = [ival]
        MSRC = [ival]
        CPSVAL = [val]
>
```

Explanation:

LINE*[iseq]*	**M**	Line sequence number.
NBEG=*[ival]*	**M**	Number of the N-line the begin grid point of the open boundary is situated on.
NEND=*[ival]*	**M**	Number of the N-line the end grid point of the open boundary is situated on.
MSRC=*[ival]*	**M**	Number of the M-line the open boundary is situated on.
CPSVAL=*[val]*	**M**	The concentration (in kgm^{-3}).

Notes:

– The boundary of the grid is the cell just within the active grid, adjacent to the velocity point where the boundary inflow of TRIWAQ is given. i..e. at MSRC = 2 or MSRC = MMAX – 1.

– The option can also be used within the grid (2 < M < MMAX-1). Then, the flow direction which is used to determine whether mass must be released follows from the quadrant of the grid where the grid cell is.

2.4.8 INSTPNTSRCS (optional)

In this section the instantaneous source and its concentration in an area is given.

```
INSTPNTSRCS
    <
        AREA [iseq]:
            MFPSI = [ival]
            MLPSI = [ival]
            NFPSI = [ival]
            NLPSI = [ival]
            KPSI = [ival]
            LMAS = [ival]
            MASPSI = [val]
            CONPSI = [val]
            DXPSI = [val]
            DYPSI = [val]
            DZPSI = [val]
            TPSI = [val]
    >
```

Note: If area is at land no action is taken.

Explanation:

AREA*[iseq]*	**M**	Area sequence number.
MFPSI=*[ival]*	**M**	Number of the begin grid point of the area in the M-direction.
MLPSI=*[ival]*	**M**	Number of the end grid point of the area in the M-direction.
NFPSI=*[ival]*	**M**	Number of the begin grid point of the area in the N-direction.
NLPSI=*[ival]*	**M**	Number of the end grid point of the area in the N-direction.
KPSI=*[ival]*	**M**	Number of the layer .
LMAS=*[ival]*	**M**	Number to specify the type of the source LMAS = 0 : source of concentration LMAS = 1 : source of mass.
MASPSI=*[val]*	**X**	The mass (in kg) per segment.
CONPSI=*[val]*	**X**	The concentration (in kgm^{-3}).
DXPSI=*[val]*	**M**	Size of the source in M-direction (in grid units).
DYPSI=*[val]*	**M**	Size of the source in N-direction (in grid units).
DZPSI=*[val]*	**M**	Size of the source in vertical direction (in layer units).
TPSI=*[val]*	**M**	Injection time of the source (in minutes relative to TFIRST).

Notes:

– If the position of the source is at the bottom KPSI has the value of the total number of layers + 1. Then the value for DZPSI = 0.0.

– The time in TPSI is a time in elapsed minutes from the beginning of the SLIB3D simulation start time.

– The value of DXPSI, DYPSI and DZPSI is supposed to be between 0.0 and 1.0 although other values are allowed. It is the size of the source with respect to the size of the grid cell.

2.4.9 CONTPNTSRCS (optional)

In this section the concentrations and positions of continuous sources in the domain are given.

CONTPNTSRCS
<
AREA[iseq]:
MFPSC = *[ival]*
MLPSC = *[ival]*
NFPSC = *[ival]*
NLPSC = *[ival]*
KPSC = *[ival]*
MASPSC = *[val]*
DXPSC = *[val]*
DYPSC = *[val]*
DZPSC = *[val]*
>

Explanation:

AREA*[iseq]*	**M**	Area sequence number.
MFPSC=*[ival]*	**M**	Number of the begin grid point of the area in the M-direction.
MLPSC=*[ival]*	**M**	Number of the end grid point of the area in the M-direction.
NFPSC=*[ival]*	**M**	Number of the begin grid point of the area in the N-direction.
NLPSC=*[ival]*	**M**	Number of the end grid point of the area in the N-direction.

KPSC=*[ival]*	**M**	Number of the layer .
MASPSC=*[val]*	**O**	The mass (in kg) per segment.
DXPSC=*[val]*	**M**	Size of the source in M-direction (in grid cells).
DYPSC=*[val]*	**M**	Size of the source in N-direction (in grid cells).
DZPSC=*[val]*	**M**	Size of the source in vertical direction.

Notes:

– If the position of the source is at the bottom KPSI has the value of the total number of layers + 1. Then the value for DZPSI = 0.0.

– The value of DXPSI, DYPSI and DZPSI is supposed to be between 0.0 and 1.0 although other values are allowed. It is the size of the source with respect to the size of the grid cell.

2.5 DECAY (optional)

In this section the effect of uniform (constant is space) decay can be taken into account.It is expressed in % per day.

DECAY
SERIES=*[text]*
FRAME=*[val1] [val2] [val3]*
| VALUES= < (*[val1] [val2]*) > (i.c. series='regular')
<
| < TIME_AND_VALUES=*[tval] [val1] [val2]* > (i.c. series='irregular')

Explanation:

SERIES=*[text]*	**O**	SERIES can have two possible values: 'regular' or 'irregular'. Then SERIES = 'regular' keywords FRAME and VALUES are expected. When SERIES = 'irregular' keyword TIME_AND_VALUES is expected.
FRAME=*[val1] [val2] [val3]*	**O**	*[val1]* is the first time for which decay is given. *[val2]* is the time interval at which decay is given. *[val3]* is the last time at which decay is given. (All these times are given in minutes)
VALUES= < (*[val1] [val2]*) >	**O**	The values for decay (=*[val1]*) (dimensionless) are given for the times as defined at the keyword frame.
TIME_AND_VALUES=*[tval] [val1] [val2]*	**O**	In this case it is possible to give decay at non-equidistant times

3 Example

3.1 General information

In the following a simple example is given of an input file for the SLIB3D package.

```
#
#  Inputfile SLIB3D TEST2 : 3 lines sources at M values
#
SET NOECHO

FILES

# Give names of all files incorporated in the process

  TRIWAQ  =  'SDS-kl1'            # Name of the TRIWAQ SDS file
  EXPTRI  =  'kustgrof'           # Name of experiment on file
  RSIFIL  =  'Rsofil_test1'       # Name of the Restart inputfile
  RSOFIL  =  'Rsofil_test2'       # Name of the Restart outputfile
  TIMFIL  =  'Timfil_test2'       # Name of the Timeseries file
  SLOFIL  =  'Masvolfil_test2'    # Name of the Sliboutput file
#

COEFFICIENTS

#

  INTEGERS

    LSLI    =     1               # Indicator which type of slib output
#                                   ( 0 means no slib output,
#                                     1 means concentrations and
#                                     2 means moments output )

  REALS

    TFIRST  =  00007890.00        # Starttime slibcomputation (in minutes)
    TLAST   =  00008640.00        # Endtime slibcomputation (in minutes)

#   DTSLI   =  00000015.00        # Timestep sliboutput in minutes
    DTSLI   =  00000030.00        # Timestep sliboutput in minutes
#   DTSLI   =  00000090.00        # Timestep sliboutput in minutes
    TFSLI   =  00007890.00        # Starttime sliboutput in minutes
    TLSLI   =  00008640.00        # Endtime sliboutput in minutes

#   DTTIM   =  00000015.00        # Timestep timeseriesoutput in minutes
    DTTIM   =  00000030.00        # Timestep timeseriesoutput in minutes
    TFTIM   =  00007890.00        # Starttime timeseriesoutput in minutes
    TLTIM   =  00008640.00        # Endtime timeseriesoutput in minutes

    KXM     =         2.00        # Horizontal diffusion in X direction
    KXY     =         0.00        # Horizontal diffusion in X,Y direction
    KYN     =         2.00        # Horizontal diffusion in Y direction

    DZNUL   =         1.0D0   # Calibrationcoeff. for vertical diffusion

    EROCOF  =         1.0D-03  # General value erosion coeff. (kg m-2 s-1)
    EROVEL  =         0.125    # General value crit. erosion veloc. (m s-1)
```

```
    SEDVEL  =         0.02     # General value crit. Sedim. veloc. (m s-1)
    GRAVAL  =         5.0D-04  # General value fall velocity (m s-1)

  OUTAREAS                          # Output areas

#   With key outarea the lines are given where TIMFIL output will
#   be produced. Each area is charact.using begin and end M and N coord.
#   however either M or N has to be constant since it concerns lines.

#   First test: whole line N=5 is outarea:
#
#   AREA  1:   MFIRST = 0002  MLAST = 0056  # Each area is charact. using
#              NFIRST = 0005  NLAST = 0005  # begin and end M and N coord.

#   Second test: only four linepieces are outarea
#
    AREA  1:   MFIRST = 0013  MLAST = 0015  # Each area is charact.using
               NFIRST = 0030  NLAST = 0030  # begin and end M and N  coord.
    AREA  2:   MFIRST = 0010  MLAST = 0010
               NFIRST = 0031  NLAST = 0031  # In this example there are 4
    AREA  3:   MFIRST = 0020  MLAST = 0020  # lines for TIMFIL output file
               NFIRST = 0020  NLAST = 0023
    AREA  4:   MFIRST = 0021  MLAST = 0021
               NFIRST = 0009  NLAST = 0021
#
#   Third test: check region surrounding the linesources with constant
concentrations

#   AREA  1:   MFIRST = 0009  MLAST = 0021
#              NFIRST = 0009  NLAST = 0009
#   AREA  2:   MFIRST = 0009  MLAST = 0021
#              NFIRST = 0021  NLAST = 0021
#   AREA  3:   MFIRST = 0009  MLAST = 0009
#              NFIRST = 0009  NLAST = 0021
#   AREA  4:   MFIRST = 0021  MLAST = 0021
#              NFIRST = 0009  NLAST = 0021

# SEDAREAS     # Sedimentation areas

#              For each region M and N for the four corners
#              next the specific values for erosion, sedimentation
#              and gravity velocity for this specific region
#
# Starttest: whole region is sedimentation area
#
#   AREA  1:   MBEG    =    0001
#              MEND    =    0057
#              NBEG    =    0001
#              NEND    =    0034
#              EROCOF  =       1.0D-3
#              EROVEL  =       0.125D+0
#              SEDVEL  =       0.02D+0
#              VAL     =       5.0D-4
#
# Second test: there are some sedimentation areas
#
#   AREA  1:   MBEG    =    0023
#              MEND    =    0024
#              NBEG    =    0023
#              NEND    =    0024
#              EROCOF  =       1.0D-3
#              EROVEL  =       0.0D+0
#              SEDVEL  =       0.0D+0
#              VAL     =       5.0D-4
```

```
#   AREA  2:   MBEG    =    0003
#              MEND    =    0014
#              NBEG    =    0020
#              NEND    =    0027
#              EROCOF  =       1.0D-3
#              EROVEL  =       0.0D+0
#              SEDVEL  =       0.0D+0
#              VAL     =       5.0D-4

# DPTHSEDAREAS # Sedimentation areas that are depth dependent
#
#   AREA  1:   MBEG    =      15
#              MEND    =      25
#              NBEG    =      10
#              NEND    =      20
#              DEPTH   =       1.0D+2
#              EROCOF  =       2.0D-5
#              EROVEL  =       8.0D-1
#              SEDVEL  =       8.0D-1
#              VAL     =       5.0D-3
#
#   AREA  2:   MBEG    =       5
#              MEND    =      10
#              NBEG    =       5
#              NEND    =       9
#              DEPTH   =       1.2D+1
#              EROCOF  =       2.5D-5
#              EROVEL  =       9.0D-1
#              SEDVEL  =       9.0D-1
#              VAL     =       5.5D-3

#              Section where linesources are given. It concerns lines where
#              the background concentration is constant. Either along lines
#              M = constant or N = constant

  PNTSRCSMBND  # Locations for linepointsources on M-boundaries

    LINE 1:    MBEG    =    0010
               MEND    =    0020
               NSRC    =    0010
               CPSVAL  =       5.0D-03

    LINE 2:    MBEG    =    0010
               MEND    =    0020
               NSRC    =    0020
               CPSVAL  =       5.0D-03

  PNTSRCSNBND  # Line Pointsource locations on N-boundaries

    LINE 1:    NBEG    =    0010
               NEND    =    0020
               MSRC    =    0010
               CPSVAL  =       5.0D-03

    LINE 2:    NBEG    =    0010
               NEND    =    0020
               MSRC    =    0020
               CPSVAL  =       5.0D-03

#   LINE 3:    NBEG    =    0016
#              NEND    =    0024
#              MSRC    =    0037
#              CPSVAL  =       7.5D-03
```

```
#
#   LINE 4:    NBEG    =    0003
#              NEND    =    0015
#              MSRC    =    0037
#              CPSVAL  =       5.0D-03
#
#   LINE 5:    NBEG    =    0003
#              NEND    =    0027
#              MSRC    =    0003
#              CPSVAL  =       5.0D-03
#
#   LINE 6:    NBEG    =    0028
#              NEND    =    0029
#              MSRC    =    0003
#              CPSVAL  =       1.0D-02
#
#   LINE 7:    NBEG    =    0032
#              NEND    =    0034
#              MSRC    =    0003
#              CPSVAL  =       1.0D-01
#
#   LINE 8:    NBEG    =    0010
#              NEND    =    0019
#              MSRC    =    0037
#              CPSVAL  =       2.5D-02
#
  INSTPNTSRCS  # Instantaneous pointsources locations

    AREA 1:

      MFPSI    =    10
      MLPSI    =    20
      NFPSI    =    10
      NLPSI    =    20
      KPSI     =     2
      LMAS     =     0  # 0 means: specify concentration CONSPI
      CONPSI   =    15
      DXPSI    =     1
      DYPSI    =     1
      DZPSI    =     1
      TPSI     =    15  # Time relative to first TFSLI!

    AREA 2:

      MFPSI    =    20
      MLPSI    =    30
      NFPSI    =    20
      NLPSI    =    30
      KPSI     =     2
      LMAS     =     1  # 1 means: specify mass by MASPSI
      MASPSI   =    50
      DXPSI    =   100
      DYPSI    =   100
      DZPSI    =    10
      TPSI     =    90  # Time relative to first TFSLI!

  CONTPNTSRCS  # Continuous pointsources locations

    AREA 1:

      MFPSC    =  019
      MLPSC    =  019
      NFPSC    =  025
      NLPSC    =  025
```

```
      KPSC     =    2
      MASPSC   =   160
      DXPSC    =    1.0D0
      DYPSC    =    1.0D0
      DZPSC    =    1.0D0

    AREA 2:

      MFPSC    =   29
      MLPSC    =   39
      NFPSC    =   10
      NLPSC    =   20
      KPSC     =    1
      MASPSC   =    8
      DXPSC    =  100
      DYPSC    =  100
      DZPSC    =   10

#
# End of Inputfile example
#
```

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