Sedtrans05

User Manual

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Authors
Urs Neumeier, Christian Ferrarin & Georg Umgiesser

Contents

Introduction

Sedtrans05 is a sediment transport model for continental shelf and estuaries. It predicts the sediment transport at one location as function water depth, sediment type, current and waves (single point model).

Sedtrans05 computes the boundary layer parameter for pure current, or pure waves or combined current-waves conditions. The threshold of movements is computed as function of grain size, sediment density, water salinity and temperature. Five different transport equations are available for non-cohesive sediments (sand). Type and dimension of bedform are also predicted and taken into account for the hydrodynamic calculations. The Cohesive Sediment Algorithm model can be used for cohesive sediment to model the full cycle of bed erosion, transport in suspension including flocculation and deposition.

Sedtrans05 is described in following publication: Neumeier U., Ferrarin C., Amos C.L., Umgiesser G. & Li M.Z. (2008) Sedtrans05: An improved sediment-transport model for continental shelves and coastal waters with a new algorithm for cohesive sediments. Computer & Geosciences. doi:10.1016/j.cageo.2008.02.007

Sedtrans05 is composed by computation routines and that can be accessed through following user interfaces. The different components are

- **Sedtrans05 GUI**, a graphic user interface for Microsoft Windows
- **SED05**, a console program for interactive or batch calculations
- **SEDI1D**, a 1D(vertical)-time model for cohesive sediment
- **Fortran77 routines** that can be integrated in other programs
- **Sedtrans05.dll**, a dynamic linked library compiled for Microsoft Windows that can be called from other programs
- **sedtrans05m**, a compiled MEX-file to access Sedtrans05 from Matlab (only compiled for Microsoft Windows)

Sedtrans05 GUI is recommended to make a few calculations, to examine how variations in some input parameters modify the results, or for teaching purpose. To process larger dataset or when the input data are already in a file, it is recommended to use *SED05* (or the Matlab function *sedtrans05m* if the data are already in Matlab).

The different components of Sedtrans05 can be downloaded from http://labsedim.uqar.ca/sedtrans05.

Sedtrans05 is be published under the GNU General public license (see Appendix D).

History of Sedtrans

Sedtrans05 is the latest version of Sedtrans, which history started in the early 1980s. The previous versions of Sedtrans were developed at the Geological Survey of Canada, Bedford Institute of Oceanography, Dartmouth, Nova Scotia. The first versions were known as "Atlantic Geoscience Centre (AGC) sediment transport model".

The two versions previous to Sedtrans05 were published by Michael Z. Li and Carl L. Amos:

Sedtrans92 – Li M.Z. & Amos C.L. (1995) SEDTRANS92: a sediment transport model for continental shelves. Computer and Geosciences, 21, 533-554.

Sedtrans96 – Li M.Z. & Amos C.L. (2001) SEDTRANS96: the upgraded and better calibrated sediment-transport model for continental shelves. Computer and Geosciences, 27, 619-645.

Limitations of Sedtrans05

Software issues:

- There is no check of the input values in the core Fortran77 routines of Sedtrans05. Some limited input checks are done in the two input interfaces, sed05.exe and Sedtrans95 GUI (Windows version), but they pick up only major problems (e.g., wave height larger than water depth). It is the responsibility of the user to assure that the input values are realistic AND within the range of validity of the different equations used. Otherwise the results will be meaningless and the program may crash.

- For SED05.exe and SEDI1D.exe, the length of each filename (inclusive path) specified as command-line argument is limited to 200 characters.

Physical limitations of Sedtrans05:

- The model assume linear wave theory and not adapted for breaking wave and the swash zone of beaches

Limitations of the Cohesive Sediment Algorithm (CSA)

- The CSA does not model sand-mud mixture, biological processes (bioconsolidation or bioturbation), lateral movement of fluid mud (due to current or gravitational forces), resuspension of fluid mud by waves or instabilities of the water-sediment interfaces (internal / Holmboe waves).

- The flocculation equations used in the CSA are valid for seawater and brackish water until salinity of about 10-15. Therefore the Cohesive Sediment Algorithm should not be used for fresh water or very low salinities.

- The CSA may not predict correctly erosion rate when long (much longer than 5 min.) time-step TIMEDR are used. Mass conservation is always respected.

- For cohesive sediment, a well-mixed water column is assumed. This is not adapted for deeper subtidal areas. Sedtrans can still be used in such situation if it is combined with a 3D hydrodynamic/sediment-transport model.

Installation of Sedtrand05 GUI

Sedtrans05 GUI should run on any computer with Windows95 or later. It was tested on Windows 98 and Windows XP.

Sedtrans05 requires 1 to 3.5 MB disc space, depending which standard run-time library files of VisualBasic 6 are already installed on the computer. In addition, 4 MB are needed for temporary files during the installation.

Setrans05 GUI is programmed in VisualBasic. In order to work correctly, some standard VisualBasic files must be copied to the SYSTEM directory and several files must be registered. Therefore is not possible to simply copy the executable, but the Sedtrans05 GUI must be installed using the setup program.

The installation files usually come as zipped file. It may be necessary to unzip them before starting the installation. After the installation, the installation files can be removed from the computer.

The installation of Sedtrans05 is started with the file "setup.exe". **The user must have ADMINISTRATOR RIGHTS for the installation.**

Any previous version of Sedtrans05 installed in the same destination directory will be automatically removed during the installation procedure. However, previous examples files for the batch version (INDATA.DAT, OUTDATA.LST INDATA.CST, which are not copied during the installation but created with the options -e), may not longer be correct after the upgrade to a newer version. They should be recreated with the commands "SED05 -e" and "SED05 -ec" before being used, because the format of input/output files may change from one version to the next..

The installations files consist of

- setup.exe
- setup.lst
- sedtrans05.cab

The installation will create a new directory (by default "C:\Program files\Sedtrans05\") and make a short cut "Menu Start" - "Programs" - "Sedtrans05".

Following files are created in the Sedtrans05 directory:

- sedtrans05.exe	The Sedtrans05 GUI program
- sedtrans05.dll	Library file containing all the computation routines
- sed05.exe	Batch version (and interactive DOS version) Sedtrans05 GUI does not use it directly
- sedtrans05.hlp	Help file for the Sedtrans05 GUI
- sedtrans05.cnt	additional data for the Help file
- sedtrans05.gid	additional data for the Help file
- readme.txt	A short explanation file

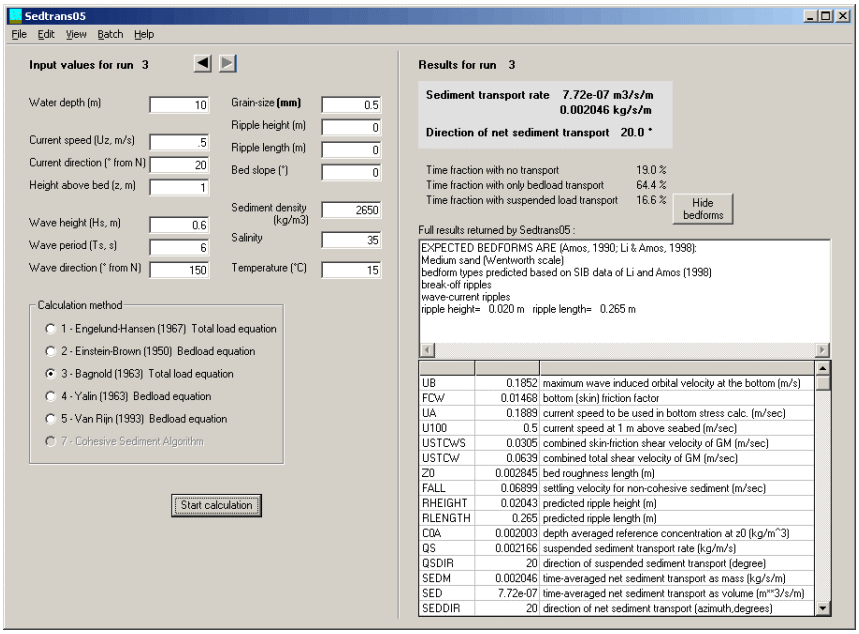
The use of the batch mode (sed05.exe) will create several other files (see "Use of SED05")

It is possible to uninstall Sedtrans05 through "Control Panel" - "Add/Remove Programs".

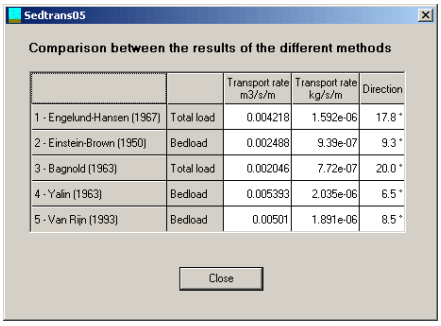
Description of Sedtrand05 GUI

Sedtrans05 GUI give the same results than SED05 for non cohesive sediments, including secondary results. However, cohesive sediments cannot be modelled with it.

Compared to the console interface SED05, Sedtrans05 has the advantage to present all the input and output parameters in one widow. The results can be copied into the system clipboard for transfer in another program. The 50 last input values and results are kept in memory, and examination how variations in some input parameters modify the results is also favoured by following functionalities:

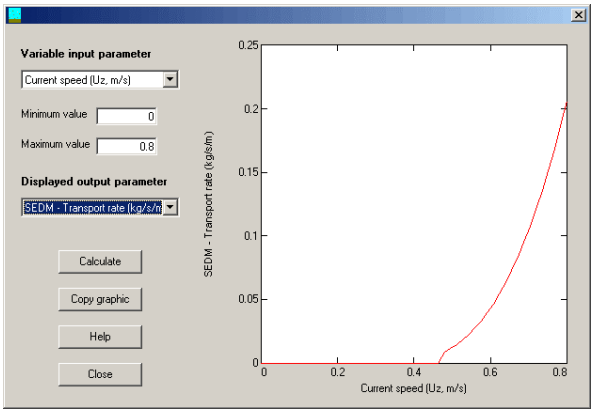


Main window of Sedtrans05

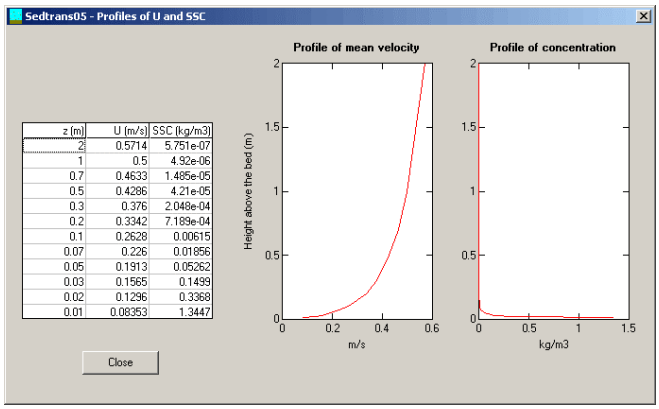


Comparison between the different calculation methods

Graphic representation of how the variation of one input parameter influence any output parameter



Profile of mean current velocity and suspended sediment concentration



Detailed instructions for using Sedtrans05 GUI are found in the help file accessed directly from the program (Menu Help – Help Setrans05, or "F1" key).

Use of SED05

SED05 is a user-interface running in a console window. It computes the sediment transport for one set of conditions. Only the file "sed05.exe" is necessary to run the interactive/batch version. The program is capable to generate example and explanation files.

The command-line option "-?" (i.e., type "sed05 -?") return a explanation of the command-line syntax of SED05, which is reproduced in the frame below.

```
Command-line syntax for using the 1D version of Sedtrans05 (version 1.03)

SED05 [-b [IN-FILE [OUT-FILE]]] [-o OUT-FILE] [-c PARAMFILE] [-f] [-h] [-v]

      -b   Batch mode with optionally names of input and output files
           (default is interactive mode)
      -o   Specify the name of the output files
      -c   Modify defaults parameters according to the file PARAMFILE
      -f   Only one tabular output file for non-cohesive sediments
      -h   No header line in tabular output files
      -v   Input water density/dyn.viscosity instead of salinity/temperature
Special options:
SED05 -?   Show the present help text
SED05 -L   Show the licence
SED05 -e   Generate an example input-file "INDATA.DAT" for batch-mode
           runs, an example file "INDATA.CST" to modify the default
           parameters and write the list of abbreviations used in the
           output files to the file "OUTPUT.LST"

IN-FILE must be with extension; default IN-FILE (batch mode) is
"INDATA.DAT". OUT-FILE must be without extension; default OUT-FILE
(batch and interactive modes) is "OUTPUT.*".
Examples of usage:
   SED05               Interactive mode with default output files
   SED05 -b cases.csv  Batch mode with input "cases.csv" and output "cases.*"
```

For the interactive version, start "sed05.exe" without any command-line parameter. Due to the significant number of input parameters required by the cohesive algorithm, interactive model computation is not available for cohesive sediments. After the first run in the interactive mode, it is possible to keep the previous input value for any parameter by giving an empty input (simply pressing RETURN).

For the batch mode (input values from a tabular text file), start with "sed05.exe" the command-line option "-b". Comment lines (lines with any text) and empty lines are ignored in the input file. This mode does not produce any screen output.

The command-line option "-e" generates an example input-file (INDATA.DAT), an explanation file for the output files (OUTPUT.LST), and an example file to modify the default parameters with the optional command-line option "-c" (INDATA.CST).

SED05 saves the results in several ASCII files, that have all the same name but different extensions (*.dat, *.da2, *.pro, *.txt, *.coh). See detailed output explanations in the file "OUTPUT.LST" (generate with "sed05 -e", also reproduced in Appendix B).

The default input file is "INDATA.DAT" and the default output files are "OUTDATA.*". It is possible to specify the filenames for input and output: for the interactive version with the command-line option "-o"; for the batch mode by specifying input and output names after the command-line option "-b".

The output files are :

- OUTDATA.txt a text file with input values, summary results and bedform predictions; the interactive mode writes the output of this file also to the screen
- OUTDATA.dat the main results in tabular format
- OUTDATA.da2 additional output parameters in tabular format
- OUTDATA.pro profiles of current velocities and (for non-cohesive sediment) suspended sediment concentration (SSC),
- OUTDATA.coh results of the cohesive sediment algorithm in tabular format (this file is only created if the cohesive sediment algorithm is used)

If no output filename but only a input filename is specified for the batch mode, and its extension not one of the output files (dat, da2, txt, pro or coh), then the input filename is also used as output filename. This property of SED05 can be used under Microsoft Windows to process a input file (with extension different from dat, da2, txt, pro or coh) directly from the "Windows Explorer" (without a consol window) by creating in the SendTo folder a shortcut with target "...\sed05.exe -b" (where ... is the location of sed05.exe).

With the command-line option "-f", all tabular output for non-cohesive sediments (normally files *.dat, *.da2 and *.pro) is written in only one file (*.dat) with 81 columns. This may be more convenient if all parameter have to be processed subsequently with another software.

The tabular output-files are tab-separated with by default a header line. The header line can be suppressed with the command-line option "-h", which produces output-files that can easier read be Matlab, Fortran program, etc.

With the command-line option "-v", the program does not calculate density and dynamic viscosity of water from salinity and temperature, but read them directly as input values. With this option the interactive version ask for density water and dynamic viscosity instead of salinity and temperature; and the batch version expects water density (kg m^{-3}) in the column containing usually salinity, and dynamic viscosity (Pa s) in the column containing usually temperature.

After the first run in the interactive mode, it is possible to keep the previous input value for any parameter by giving an empty input (simply pressing RETURN).

All dimensional variables are in SI units. The grain-size is in metres, and not in mm as in the graphic user interface Sedtrans05 GUI.

Some limited input checking is done. When a clearly impossible value is noticed, this input value is refused in the interactive mode, in the batch mode the calculations are aborted and an error code is written in the output files. All errors or warnings are reported in the text output file *.txt, but only the first error or warning is specified in the tabular output file *.dat. See also general limitations of Sedtrans05 below.

If the command-line option "-c" is used to modify some coefficients for the cohesive sediment algorithm, the modified value are written in an additional output file *.log.

See also the section "Instructions for the Cohesive Sediment Algorithm" in this readme file.

Use of sedtrans05m

sedtrans05m is a MEX-file function to call the Fortran77 subroutines directly from Matlab. It operates like SED05 or a direct call the calculation routines from another program. However, sedtrans05m has the advantage that it is not necessary to generate an input data file and then to read the output data files, if the input data are already in Matlab and the output is afterward processed in Matlab.

When a compiled MEX-file is available for your operating system/processor type (*sedtrans05m.dll* for Windows, *sedtrans05m.so* for Linux), copy the compiled MEX-file and the file *sedtrans05m.m* in the current Matlab directory or in a directory that is on the Matlab path.

To compile the MEX-file, copy the source files (including *sedtrans05m.f* and *sedtrans05dll.f*) to the current Matlab directory, and then type "mex sedtrans05m.f" at the Matlab prompt. It is possible that Matlab must be configured for your Fortran compiler, type "mex -help" at the Matlab prompt for information how to proceed.

The syntax for using sedtrans05m is described in the file sedtrans05m.m, which can be shown by typing "help sedtrans05m" at the Matlab prompt, and which is reproduced below.

```
   OUT1 = SEDTRANS05M(IN1)
   ... = SEDTRANS05M(IN1,CONC,BEDCHA)
   ... = SEDTRANS05M(IN1,CONC,BEDCHA,IN2)
   [OUT1,OUT2,OUT3,PROFILE,BEDTXT,CONC,BEDCHA] = SEDTRANS05M(...)

For non-cohesive sediments (1 <= IOPT <= 5) SEDTRANS05M takes 1 input argument.
For cohesive sediments (IOPT = 7) SEDTRANS05M takes 3 or 4 input arguments.
Between 1 and 7 output arguments can be requested.

The input and output variables to Sedtrans05 are bundled into several
arrays that follow the parameter order of the input/output
files of the batch version SED05 (except the columns IRUN and ERR).

IN1 can be an array of 15 (or 17) columns, if all IOPT1<=5 (non-cohesive) and
only output arguments OUT1 and OUT2 are requested.

Array IN1(17)  Input variables to Sedtrans, for non-cohesive sediments
               IN1 can also be 15 or 16 elements long
 1: IOPT1    selection of sediment transport equation (1,2,3,4,5,7 or 10)
 2: D        water depth (m)
 3: UZ       current speed (m/s)
 4: Z        height of current measurement (m)
 5: CDIR     current direction (degrees north)
 6: HT       wave height (m)
 7: PER      wave period (seconds)
 8: WDIR     wave direction (degrees north)
 9: GD       grain size (m)
10: RHINP    ripple height (m)
11: RLINP    ripple length (m)
12: BETA     bed slope (degree)
13: RHOS     grain density (default=2650, kg/m**3)
14: SALIN    salinity (default=35)
15: TEMP     temperature (degrees Celsius)
16: TIMEDR   deposition/erosion duration (seconds)             * OPTIONAL
17: AULVA    fraction of bed area covered by Ulva (range 0-1)  * OPTIONAL
```

```
Array IN2(30)  ! Default parameters for cohesive algorithm
               ! with the value -999. the default value is not modified
 1: SWITCH    if =0, then IN2 is ignored
              if <>0, then IN2 is processed
 2: CSULVA
 3: TMULVA
 4: TRULVA
 5: RKERO
 6: E0
 7: CDISRUPT
 8: CLIM1
 9: CLIM2
10: KFLOC
11: MFLOC
12: RHOCLAY
13: CTAUDEP
14: PRS
15: RHOMUD
16: DPROFA
17: DPROFB
18: DPROFC
19: DPROFD
20: DPROFE
21: CONSOA
22: TEROA
23: TEROB
24: TEROC
25: TEROD
26: CDRAGRED
27: Z0COH
28: FCWCOH
29: WSCLAY
30: DOCOMPACT

CONC(21)       ! Cohesive SSC

BEDCHA(20,3)   ! Description of cohesive bed
                 column 1 : depth below surface (m)
                 column 2 : critical erosion shear stress (Pa)
                 column 3 : dry bulk density (kg/m3)

Array OUT1(16) ! Results (similar to file *.dat)
 1: UB        maximum wave induced orbital velocity at the bottom (m/s)
 2: FCW       bottom (skin) friction factor
 3: UA        current speed to be used in bottom stress calc. (m/sec)
 4: U100      current speed at 1 m. above seabed (m/sec)
 5: USTCWS    combined skin-friction shear velocity of GM (m/sec)
 6: USTCW     combined total shear velocity of GM (m/sec)
 7: Z0        bed roughness length (m)
 8: FALL      settling velocity for non-cohesive sediment (m/sec)
 9: RHEIGHT   predicted ripple height (m)
10: RLENGTH  predicted ripple length (m)
11: C0A      depth averaged reference concentration at z0 (kg/m^3)
12: QS       suspended sediment transport rate (kg/m/s)
13: QSDIR    direction of suspended sediment transport (degree)
14: SEDM     time-averaged net sediment transport as mass (kg/s/m)
15: SED      time-averaged net sediment transport as volume (m**3/s/m)
16: SEDDIR   direction of net sediment transport (azimuth,degrees)

Array OUT2(26) ! Results (similar to file *.da2)
 1: AB        excursion length of bottom wave orbit (m)
 2: WL        wave length (m)
 3: USTCRB    critical shear vel for initi of bedload trans (m/sec)
 4: USTCRS    critical shear vel for initi of suspended load transport (m/sec)
 5: USTUP     critical shear vel for initn of sheet flow transport (m/sec)
 6: Z0C       apparent bed roughness length (m)
 7: PHIB      angle between wave and current directions (radians)
 8: PHI100    angle between wave and current directions at 1 m. above seabed
```

```
 9: DELTACW  height of the wave-current boundary layer
10: USTCS    current skin-friction shear velocity of GM
11: USTWS    wave skin-friction shear velocity of GM
12: USTCWSE  effective combined skin-friction shear velocity
13: USTCWSB  transport-related combined shear velocity
14: USTC     total current shear velocity of GM
15: USTW     total wave shear velocity of GM
16: RPLCOEF  ripple coefficient for shear velocity conversion
17: TB1      time at which bedload transport ceases (sec)
18: TB2      time at which bedload transport recommences (sec)
19: TS1      time at which suspended load transport ceases (sec)
20: TS2      time at which suspended load transport recommences (sec)
21: PERBED   percentage of time spent in only bedload transport phase
22: PERSUSP  percentage of time spent in suspended load transport phase
23: C0       reference concentration at z0 (kg/m^3)
24: TAOCWS   averaged effective shear stress
25: RHOW     water density (kg/m3)
26: VISC     dynamic viscosity of water (Pa s)

Array OUT3(5) ! Results (similar to file *.coh)
1: TAUEFF    effective To, includes drag reduction and TAOS (Pa)
2: TAOS      solid transmitted stress due to Ulva (Pa)
3: ZS        height change in bed surface (m) (positive: erosion, negative:
deposition)
4: EDRATE    mean erosion/deposition rate (kg/m**2/s) (positive: erosion,
negative: deposition)
5: TCONC     final total suspended sediment concentration (kg/m**3)

Array PROFILE(12,3) ! SSC and velocity profile (non-cohesive)
1st column: Zi  height above the bed (m)
2nd column: Ci  suspended sediment concentration at height Zi (kg/m**3)
3rd column: Ui  mean velocity at height Ui (m/s)


With IOPT1=10, the COHESIVE subroutine is called directly, without passing
through the main subroutine SEDTRANS05. In this case, CONC, BEDCHA and IN2
are processed normally, but only followings parameters contained in IN1
are considered: D, UZ (which then does not represent velocity but
TAUCWS=RHOW*USTCWS**2), SALIN, TEMP,TIMEDR and AULVA.
From the output arguments, only RHOW, VISC (in OUT2),
EDRATE,ZS,SEDM,TCONC,TAOS (in OUT3), CONC and BEDCHA are assigned.
All the other output arguments are undefined !
```

Use SEDI1D

SEDI1D is a particular interface to Sedtrans05 that simulate a 1D(vertical)-time model for cohesive sediment. It assumes an infinite, homogeneous, horizontal bed, which is subject to various current and wave conditions over time. This simple model is not designed to represent a natural environment, but it is perfectly adapted for modelling processes observed in an annular flume. It was specifically written for comparing the cohesive algorithm with experimental results in annular flumes. It is made available because it may be useful for other persons, but it was developed and tested to be a robust, user-friendly and versatile program. Therefore some adaptations in the code may be necessary for particular situations.

The command-line option "-?" displays the explanations of the command-line syntax, which is reproduced in the frame below.

```
Command-line syntax for using the 1D-time version of Sedtrans05 (version 1.02)

SEDI1D -?  Show the present help text
SEDI1D     By default the input file is "IN1D.DAT"
           and output files are "OUT1D.*",

The files can also be specified as follow:
SEDI1D inputfile
SEDI1D inputfile outputfile
SEDI1D inputfile outputfile -c paramfile     Modify the defaults parameters
                                             according to the file "paramfile"

"inputfile" must be with extension, "outputfile must be without extension.

SEDI1D -L  Show the licence
SEDI1D -e  Generate the example files "IN1D.DAT" (input data) and
           "INDATA.CST" (modification of default parameters), and write the
           list of abbreviations used in the output files to the file
           "OUT1D.LST"
```

SEDI1D reads input parameters from a file containing:
- on the first data line, the initial bed characteristics and the initial SSC;
- on the other data lines, several successive hydrodynamic conditions, each with a specific duration.

The hydrodynamic conditions can be defined with the same input parameters as for SED05. Alternatively, τ_0 can be specified directly; in this case the subroutine with the cohesive sediment algorithm (COHESIVE) is called directly, without passing through the main subroutine SEDTRANS05. See the comments in the example input-file IN1D.DAT, which is generated with the command-line option "-e", for more details.

The output is a tabular text file with SSC and bed characteristics for each minute or each calling interval (whichever is shorter). See the explanation file OUT1D.LST, which is generated with the command-line option "-e", for more details.

If error or warning are generated, they are reported in the text output file *.txt, but only the first error or warning is specified in the tabular output file *.dat.

If the command-line option "-c" is used to modify some coefficients, the modified value are written in an additional output file *.log.

Instruction for the Cohesive Sediment Algorithm

Compilation of the source code

The main elements of Sedtrans05 (the calculations routines and the interfaces SED05 and SEDI1D are written in FORTRAN77. They were developed with the compiler "g77", that is freely available at http://www.gnu.org/software/fortran/

The code follow the FORTRAN77 standard with following exception:
- "IMPLICIT NONE" statements,
- comments starting with "!"
- names of variables and routines longer than 6 characters
- "INCLUDE" statements
- calls to 2 functions retrieving the command-line arguments, which are specific to the compiler g77 (IARGC and GETARG); however the code can easily be modified to skip this code section.

The source files for **SED05** (console program for interactive or batch calculations) consist of

- sed05.f
- sedtrans-core.f
- cohesive.f
- bedform.f
- sed_param.h

The main file is sed05.f, which contains "INDCLUDE" statements making reference to all the other code files. Therefore only sed05.f has to be specified to the compiler.

The source files for **SEDI1D** (1D(vertical)-time model for cohesive sediment) consist of

- sedi1d.f
- sedtrans-core.f
- cohesive.f
- sed_param.h

The main file is sedi1d.f, which contains "INCLUDE" statements making reference to all the other code files. Therefore only sedi1d.f has to be specified to the compiler.

The source files for the **computation routines** (accessed through the subroutine SEDTRANS05) consist of

- sedtrans-core.f contains the subroutine SEDTRANS05
- cohesive.f referred from sedtrans-core.f with an INCLUDE statement.
- sed_param.h definition of the COMMON blocks.

The source files for **sedtrans05m** (MEX-file for Matlab) consist of

- sedtrans05m.f (the gateway routine)

- sedtrans05dll.f
- sedtrans-core.f
- cohesive.f
- bedform.f
- sed_param.h
- sedtrans05m.m (the help file explaining the usage of the MEX-file)

The main file is sedtrans05m.f, which contains "INDCLUDE" statements making reference to all the other code files. Therefore only sedtrans05m.f has to be specified when compiling the MEX-file from Matlab. Compilation was tested with Matlab 6.1 and g77 as Fortran77 compiler.
sedtrans05m.m is the help file explaining the usage of the MEX-file. It is recommended to keep sedtrans05m.m together with the compiled MEX-file.

The source files for **DLL**-executable (dynamic link library for Microsoft Windows) consist of

- sedtrans05dll.f
- sedtrans-core.f
- cohesive.f
- bedform.f
- sed_param.h
- sedtrans05dll.def

The main file is sedtrans05dll.f, which contains "INDCLUDE" statements making reference to all the other code files. Therefore only sedtrans05dll.f has to be specified when creating the object file with the compiler. For producing the DLL, dllwrap requires also sedtrans05dll.def, which contains the list of subroutine to be exported.

The source files for **Sedtrans05 GUI** (graphic user interface for Microsoft Windows) consist of

- About_form.frm
- About_form.frx
- Batch_form.frm
- Batch_form.frx
- Fcomparison.frm
- Fcomparison.frx
- Fmain.frm
- Fmain.frx
- Fprofiles.frm
- Fprofiles.frx
- Fsensitivity.frm
- Fsensitivity.frx
- GraphFun.bas
- Licence_form.frm
- Licence_form.frx
- Module1.bas
- Module2.bas
- SEDTRANS05.HLP
- sedtrans05w.vbp
- sedtrans05w.vbw
- sedtrans05.dll
- sed05.exe

Sedtrans05GUI is programmed in Visual Basic 6. The project file is sedtrans05w.vbp. The call to sedtrans05.dll (included in the source files, but can also be compiled separately, see above) does not work when the program is executed within the Visual Basic programming environment. The program must be compiled, and then sedtrans05.dll be placed in the same directory than sedtrans05.exe.
sed05.exe (compiled console program for batch calculations) is included in the source files. When placed in the same directory than sedtrans05.exe, it can be called directly from Sedtrans05GUI.

Direct access to the computation routines from other programs

It is possible to access the single-point model Sedtrans05 from other program, either to develop another user interface, or to integrate Sedtrans05 in larger 2D/3D hydrodynamic/sedimentary models.

All the computations in Sedtrans05 is accessed through the subroutine SEDTRANS05 (in the file "sedtrans-core.f"), with following two exceptions:
- the text of the bedform predictions is generated in the subroutine BEDFORM (in the file "bedform.f"), and
- density and viscosity of water is computed from salinity and temperature in the subroutine DENSVISC (in the file "cohesive.f").

Before the first call to SEDTRANS05, it is necessary to make one call to the subroutine INICONST.

The input parameters of Sedtrans05 are transmitted as arguments to SEDTRANS05. The main results are returned as arguments from SEDTRANS05, additional results are returned in the common blocks OSCL, THRE, FRICF, TIMIN, PROF, PROFIL (definition of common blocks in file "sed_param.h").

For explanations of the input/output argument of SEDTRANS05, see the beginning of the SEDTRANS05 subroutine. For explanations of the additional results see the comments in the file "sed_param.h".

NO input argument check is done in the subroutine SEDTRANS05

Specific for the non-cohesive methods (call to SEDTRANS05 with IOPT<>7):

+ If IOPT1.NE.7, then none of the input arguments for the Cohesive Sediment Algorithm will be accessed; the arguments BEDCHA and CONC do not have to be arrays in this case.

Specific for the Cohesive Sediment Algorithm (call to SEDTRANS05 with IOPT=7):

+ Various constants and parameters of the Cohesive Sediment Algorithm are specified in the common block CCONST, which is initialized by the subroutine INICONST. Expert users can change these constants/parameters by declaring the common block CCONST (using "INCLUDE sed_param.h") in the calling program and modifying some values AFTER the call to INICONST.

+ The subroutine BEDINI (in file "cohesive.f") is NOT tested so far.

+ The subroutine COMPACT (in file "cohesive.f") is NOT tested so far.

+ The array variable BEDCHA (describing the variations of the cohesive bed with depth) must have at least 3 row and may have up to 50 rows. The function CHECKBEDCHA can be used to check that information in BEDCHA is valid.

+ The dimension of the input/output argument CONC (concentration of each class of suspended sediment) is specified with the PARAMETER variable NBCONC in the file "sed_param.h". The settling velocity Ws of each element of CONC is specified in the common block WSCLASS, variable WSI. INICONST must have been called once before WSI is accessed.
  To use CONC, the best is include the 2 following lines:
  ```
  INCLUDE "sed_param.h"
  DOUBLE PRECISION CONC(NBCONC)
  ```

+ See also the section "Instruction for the Cohesive Sediment Algorithm" in this manual.

Appendix A : example input files

Below is the example file "INDATA.DAT generated with version 1.02 of SED05 by using the command-line option "-e".

```
Example of an input file for the batch mode of Sedtrans05 (version 1.02)
Comment lines (any line containing non numerical characters)
and empty lines are ignored.
The numerical values in the file must be separated by spaces,
commas, or tabulators.
The input format is different for non-cohesive and cohesive
sediment. Both input types can be mixed in the same file.

For the non-cohesive equations, the input format is
IRUN IOPT1 D  UZ Z  CDIR  HT PER   WDIR  GD RHINP RLINP BETA  RHOS  SALIN TEMP
1 2  2.2   0.8   0.5   30.5  0.3   3.5   185.  0.00035  0.0   0.0   -2.0  2650. 35.   15.

For cohesive sediment, the input format is
IRUN IOPT1 D  UZ Z  CDIR  HT PER   WDIR  GD RHINP RLINP BETA  RHOS  SALIN TEMP  TIMEDR   AULVA c1 c2 c3 c4 c5 c6 c7 c8 c9 c10
  c11   c12   c13   c14   c15   c16   c17   c18   c19   c20   c21   NBED  z1 z2 z3 z4 Tero1 Tero2 Tero3 Tero4 rho1  rho2  rho3
  rho4
2 7  2.2   0.8   0.5   30.5  0.3   3.5   185.  0.0   0.0   0.0   0.0   2650. 35.   15.   300.  0.0   0.0   0.0   0.0   0.0
  0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   4  0.0   0.005 0.02
  0.05  0.2   0.3   0.4   0.45  200   300   400   450

Meaning of the abbreviations
IRUN      identifier for the run (integer value)  #
IOPT1     selection of sediment transport equation (1,2,3,4,5 or 7)  #
D         water depth (m)
UZ        current speed (m/s)
Z         height of current measurement (m)
CDIR      current direction (degrees north)
HT        wave height (m)
PER       wave period (seconds)
WDIR      wave direction (degrees north)
GD        grain size (m)
RHINP     ripple height (m)
RLINP     ripple length (m)
BETA      bed slope (degree)
RHOS      grain density (default=2650, kg/m**3)
SALIN     salinity (default=35)
TEMP      temperature (degrees Celsius)
TIMEDR    deposition/erosion duration (seconds)
AULVA     fraction of bed area covered by Ulva (range 0-1)
c1-c21    suspended sediment concentration of each Ws class
NBED      number (N) of entries in BEDCHA  #
z1-zN     depth (positive downward, m)
rho1-rhoN    dry bulk density (kg/m**3)
Tero1-TeroN  critical erosion stress (Pa)

#  if a real number is given for these parameters, it will be rounded to the nearest integer
```

Appendix B : Explanation of the output files

Below is the file "OUTDATA.LST" generated with version 1.02 of SED05 by using the command-line option "-e". The output parameters may vary in future versions of the program. Only the OUTDATA.LST file generated with each program version is certain to described correctly the output of that version.

```
Abbreviations used in the output files of Sedtrans05 (interactive/batch version,
version 1.02)

In the output file *.dat (main results)

IRUN    identifier for the run (integer value)
ERR     error/warning code (see below)
UB      maximum wave induced orbital velocity at the bottom (m/s)
FCW     bottom (skin) friction factor
UA      current speed to be used in bottom stress calc. (m/sec)
U100    current speed at 1 m. above seabed (m/sec)
USTCWS  combined skin-friction shear velocity of GM (m/sec)
USTCW   combined total shear velocity of GM (m/sec)
Z0      bed roughness length (m)
FALL    settling velocity for non-cohesive sediment (m/sec)
RHEIGHT predicted ripple height (m)
RLENGTH predicted ripple length (m)
C0A     depth averaged reference concentration at z0 (kg/m^3)
QS      suspended sediment transport rate (kg/m/s)
QSDIR   direction of suspended sediment transport (degree)
SEDM    time-averaged net sediment transport as mass (kg/s/m)
SED     time-averaged net sediment transport as volume (m**3/s/m)
SEDDIR  direction of net sediment transport (azimuth,degrees)


In the output file *.da2 (additional parameters)

IRUN    identifier for the run (integer value)
AB      excursion length of bottom wave orbit (m)
WL      wave length (m)
USTCRB  critical shear vel for initi of bedload trans (m/sec)
USTCRS  critical shear vel for initi of suspended load transport (m/sec)
USTUP   critical shear vel for initn of sheet flow transport (m/sec)
Z0C     apparent bed roughness length (m)
PHIB    angle between wave and current directions (radians)
PHI100  angle between wave and current directions at 1 m. above seabed
DELTACW height of the wave-current boundary layer
USTCS   current skin-friction shear velocity of GM
USTWS   wave skin-friction shear velocity of GM
USTCWSE effective combined skin-friction shear velocity
USTCWSB transport-related combined shear velocity
USTC    total current shear velocity of GM
USTW    total wave shear velocity of GM
RPLCOEF ripple coefficient for shear velocity conversion
TB1     time at which bedload transport ceases (sec)
TB2     time at which bedload transport recommences (sec)
TS1     time at which suspended load transport ceases (sec)
TS2     time at which suspended load transport recommences (sec)
PERBED  percentage of time spent in only bedload transport phase
PERSUSP percentage of time spent in suspended load transport phase
C0      reference concentration at z0 (kg/m^3)
TAOCWS  averaged effective shear stress
RHOW    water density (kg/m3)
VISC    dynamic viscosity of water (Pa s)
```

In the output file *.pro (velocity and concentration profile
for non-cohesive sediments)

IRUN   identifier for the run (integer value)
Zi   height above the bed (m)
Ci   suspended sediment concentration at height Zi (kg/m**3)
Ui   mean velocity at height Ui (m/s)

In the output file *.coh (results for cohesive sediments)

IRUN   identifier for the run (integer value)
ERR   error/warning code (see below)
TAU0EFF effective To, includes drag reduction and TAOS (Pa)
TAOS   solid transmitted stress due to Ulva (Pa)
UNUSED height change in bed surface (m)
        (positive: erosion, negative: deposition)
EDRATE mean erosion/deposition rate (kg/m**2/s)
        (positive: erosion, negative: deposition)
TCONC   final total suspended sediment concentration (kg/m**3)
NBCONC number of classes of suspended sediment
Ci   suspended sediment concentration for each class (kg/m3)
bed characteristics (BEDCHA):
MAXBED number of elements in Z, Tero and rho
Zi   depth below surface (m)
Tero_i critical erosion stress at depth Zi (Pa)
rho_i   dry bulk density at depth Zi (kg/m**3)

Settling velocities (Ws) for each suspended sediment
class of cohesive sediment

Class	Ws (m/s)
1	0.000010
2	0.000016
3	0.000025
4	0.000040
5	0.000063
6	0.000100
7	0.000158
8	0.000251
9	0.000398
10	0.000631
11	0.001000
12	0.001585
13	0.002512
14	0.003981
15	0.006310
16	0.010000
17	0.015849
18	0.025119
19	0.039811
20	0.063096
21	0.100000

Error and warning codes
Only one error/warning code is specified in the file *.dat
The full list of error/warning is given in the file *.txt

0 No error or warning

Critical errors

1 Incorrect input argument D
2 Incorrect input argument UZ
3 Incorrect input argument Z
4 Incorrect input argument CDIR
5 Incorrect input argument HT

```
  6 Incorrect input argument PER
  7 Incorrect input argument WDIR
  8 Incorrect input argument GD
  9 Incorrect input argument RHINP
 10 Incorrect input argument RLINP
 11 Incorrect input argument BETA
 12 Incorrect input argument SALIN
 13 Incorrect input argument RHOS
 14 Incorrect input argument AULVA
 15 Incorrect value for NBED
 16 Incorrect input argument TIMEDR
 17 Incorrect input argument BEDCHA
 18 Incorrect input argument CONC
 19 Incorrect input argument TEMP
 20 Incorrect input argument DT
 21 Incorrect input argument USTCWS
 22 Incorrect input argument ARG4
 23 Incorrect input argument OBS2
 24 Incorrect input argument ROT
 30 Incorrect input argument IOPT1

Warnings

101 ENGELUND-HANSEN formula not recommended for use with sediments finer than
    0.15 mm
102 EINSTEIN-BROWN formula is based on laboratory experiments using sediments
    with grain sizes of 0.3 to 28.6 mm
103 BAGNOLD formula is based on laboratory tests with grain sizes between 0.18
    and 0.45 mm
104 YALIN formula is not recommended for use with sediments smaller than 0.2mm,
    based on the results of sensitivity analyses
105 VAN RIJN formula is based on laboratory experiments using sediments
    with grain sizes of 0.2 to 2.0 mm
107 The cohesive algorithm is not intended for non-cohesive sediments
```

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Version 1.2, November 2002

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Version 3, 29 June 2007

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