

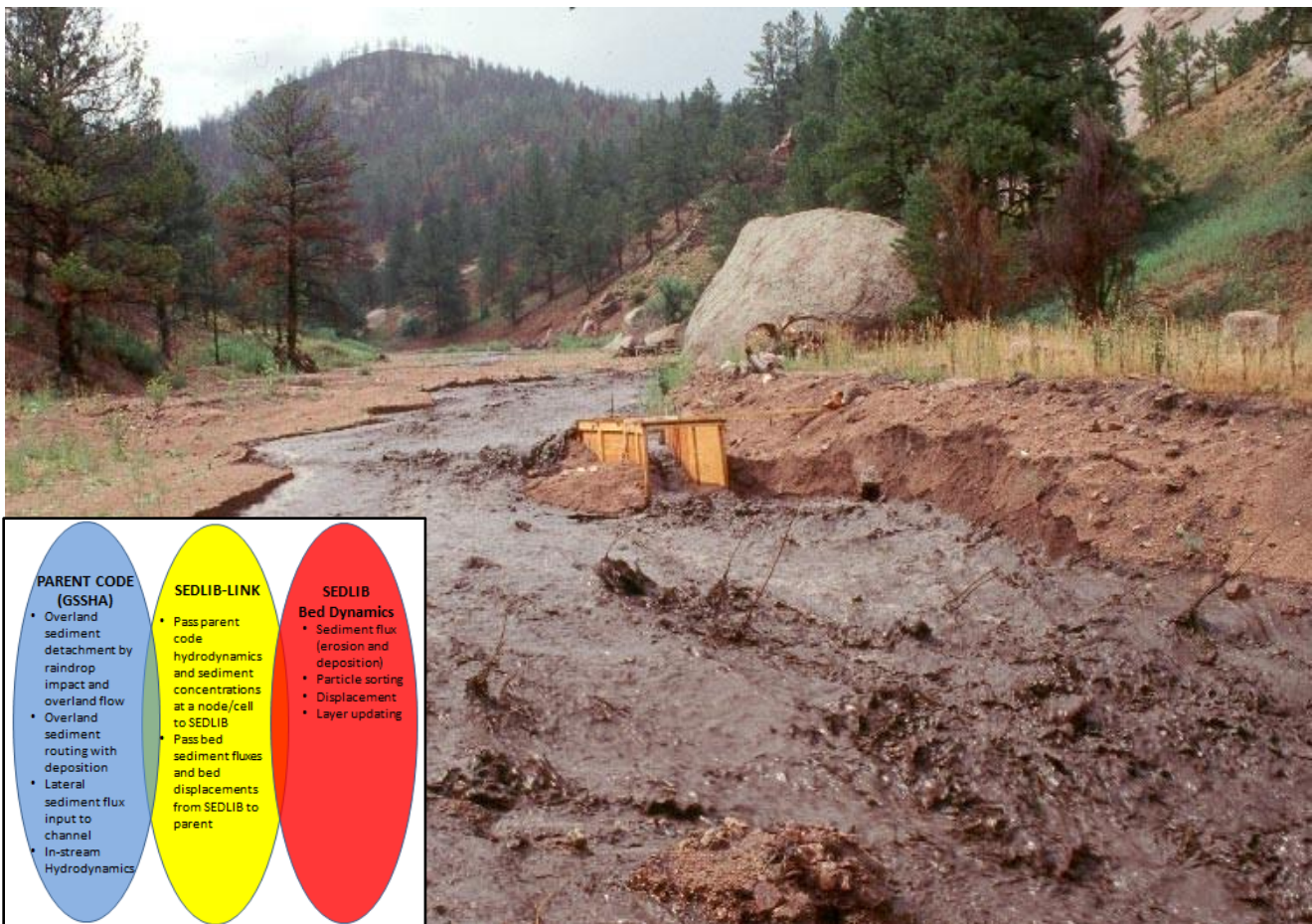
Tutorial for GSSHA instream sediment model

and

GSSHA/SEDLIB and WMS interface development

Simulation of in-stream soil erosion using GSSHA and SEDLIB sediment transport library.

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Prerequisite Tutorials

Overland soil erosion in GSSHA

(available at: <http://wmstutorials-11.0.aquaveo.com/GSSHA-SedimentTransport.pdf>)

The same project in the tutorial (<http://wmstutorials-11.0.aquaveo.com/GSSHA-SedimentTransport.pdf>) is extended for incorporating WMS visual interface for GSSHA instream sediment input / output.

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1 Introduction

The objective of this tutorial is to learn how to set up a simulation of in-stream sediment transport, including in-stream erosion and deposition, by running GSSHA coupled with the SEDLIB sediment transport library. SEDLIB is capable of solving problems consisting of multiple grain sizes, cohesive and cohesionless sediment types, and multiple layers. SEDLIB calculates erosion and deposition processes simultaneously, and simulates such bed processes as armoring, consolidation, and discrete depositional strata evolution. The main purpose of this tutorial is to demonstrate how to invoke SEDLIB to perform in-stream sediment transport in GSSHA.

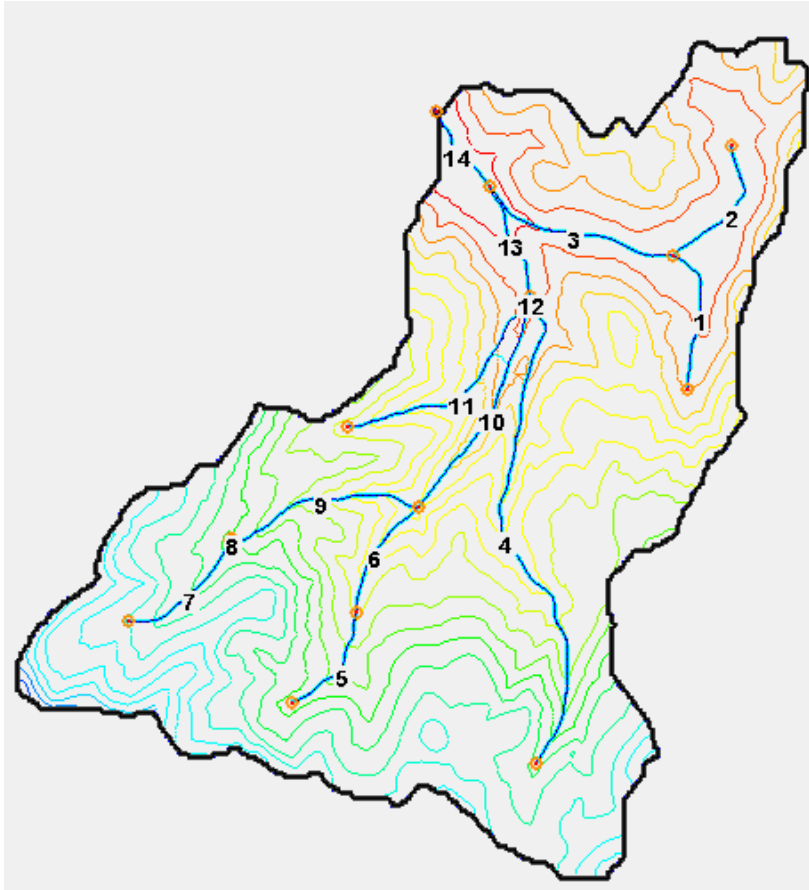
2 Open an Existing GSSHA Project

Browse and find the previously set up overland sediment simulation model. It will be found in your parent or personnel directory in the sediment folder – **..\Sediment\ sed.prj**. This test case model has been set up as part of Tutorial 53 to simulate GSSHA overland soil erosion. If you have completed this tutorial then you will use the project that you built and saved as **..\ Personal\Sediment\ sed.prj**. If not, you can find the project file in the **Sediment** folder in the parent directory. In this tutorial you will enhance your project and perform the in-stream sediment transport simulation with the SEDLIB library.

The implementation of SEDLIB adds the capability to simulate erosion and deposition of both sands and fines (silt and clays) in the channel network. Previous versions of GSSHA treated the fines as wash load and did not permit interaction of fines with the in-stream sediment bed, so the implementation of SEDLIB is an improvement on the existing capability of the model. Also, SEDLIB tracks discrete sediment layers in the bed, so, for example, the model can be used to ascertain whether sequestered material (in deep layers) is exposed by erosion in the channel network.

In this tutorial, we will define both sediment grain properties for in-channel transport, and sediment bed properties for in-channel bed initialization. Finally, we will compare the sediment flux at the outlet of the watershed with and without the instream erosion/deposition of fines, to demonstrate some of the extended capability afforded by SEDLIB.

1. While WMS does not currently have the capability to set up GSSHA/SEDLIB models, you will use WMS to view the model before editing it with other program. **Browse and open the file sed.prj in WMS.** You will see the following project:

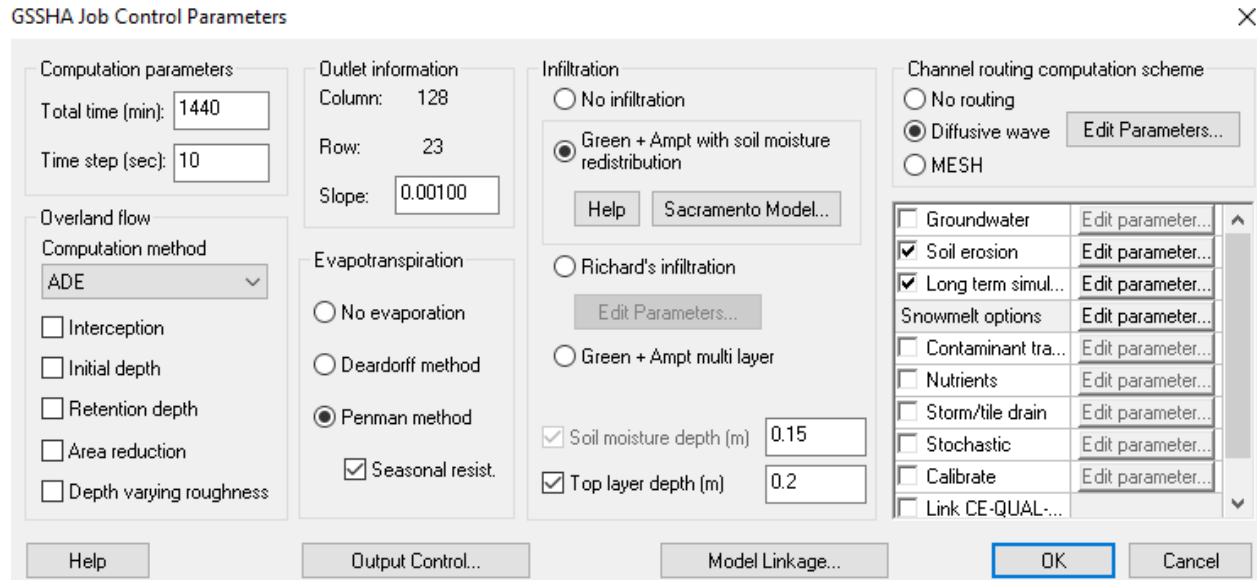


Select the 2-D-Grid Module .

Select 'GSSHA' on the menu bar.

Click 'Job Control'

The soil erosion simulation is already turned on.



WMS does not have visual interface developed for newly enhanced capability to take account of the SEDLIB instream soil erosion capability in GSSHA.

Save the project as **..\Personal\Sediment\with_instream_sed.prj**.

Close WMS.

3 Setting up the in-stream soil erosion simulation

Since WMS does not currently support the SEDLIB functionality in GSSHA, you will use a text editor to set up the in-stream soil erosion simulation in the GSSHA project. You will use a text editor to modify and add the **'STREAM_SED'** control cards to the project file. You will also open and view the SEDLIB input file with the following steps:

i) Modify the sediment project control file

Open the GSSHA project file named **'with_instream_sed.prj'** in the text editor.

Go to the **..\Sediment** folder and open the file **'additional project cards.txt'** in the text editor (Note: this is not a GSSHA file).

Copy the project cards in the file **'additional project cards.txt'** and paste it at the bottom of the content of the file **'with_instream_sed.prj'**.

The **'gssha_sedlib.slb'** file is the file that will be used to define the grain properties and the bed initialization properties necessary to invoke SEDLIB for in-channel sediment transport.

This is how the project file will look like once the addition cards are added:

```

GSSHAPROJECT
WMS WMS 8.4 (64-Bit)
WATERSHED_MASK      "Sed.msk"
PROJECT_PATH        ""
NON_ORTHO_CHANNELS
FLINE               "Sed.map"
METRIC
QOUT_CFS
GRIDSIZE            25.000000
ROWS                257
COLS                242
TOT_TIME            1440
TIMESTEP            10
OUTROW              23
OUTCOL              128
OUTSLOPE            0.001000
MAP_FREQ            180
HYD_FREQ            15
MAP_TYPE            1
ELEVATION           "Sed.ele"
DEPTH               "Sed.dep"
CHAN_DISCHARGE      "Sed.cdq"
DIFFUSIVE_WAVE
CHANNEL_INPUT       "Sed.cif"
STREAM_CELL         "Sed.gst"
OVERTYPE            ADE
ET_CALC_PENMAN
SEASONAL_RS
INF_REDIST
SOIL_MOIST_DEPTH    0.150000
TOP_LAYER_DEPTH     0.200000
MAPPING_TABLE       "Sed.cmt"
ST_MAPPING_TABLE    "Sed.smt"
SUMMARY             "Sed.sum"
OUTLET_HYDRO        "Sed.otl"
QUIET
SUPER_QUIET
PRECIP_FILE         "Sed.gag"
RAIN_INV_DISTANCE
LONG_TERM
LATITUDE            40.633192
LONGITUDE           291.491794
GMT                 -6.000000
EVENT_MIN_Q         0.100000
HMET_WES            "hmet3.hmt"
SOIL_EROSION        3
OUTLET_SED_FLUX     "Sed.sed"
OUTLET_SED_TSS      "Sed.oss"
ADJUST_ELEV         "Sed.adj.ele"
MAX_SED_FLUX        "Sed.flx"
VOL_SED_SUSP        "Sed.sus"
CHAN_SED_FLUX       "Sed.cfx"
WATER_TEMP          20.000000
SED_POROSITY        0.400000
SAND_SIZE           0.250000
IN_HYD_LOCATION     "Sed.ihl"
OUT_HYD_LOCATION    "Sed.ohl"
SEDLIB              "gssha_sedlib.slb"

```

Save the project control file (.prj) file.

ii) View the SEDLIB input file

Similarly, open and view the file 'gssha_sedlib.slb' in the text editor (Note: this is input file for SEDLIB).

GSSHASEDLIBFILE			
GRN_CLS_NUM	3		
NUM_BED_LAYERS	2		
GRN_CLS_DIA	0.00025	0.000016	0.000001
GRN_CLS_SET_VEL	0.01	0.001	0.00005
GRN_CLS_SPGRAV	2.65	2.65	2.65
GRN_CLS_PORO	0.4	0.5	0.5
GRN_CLS_CR_EROSION_SHEAR	1.0	1.0	1.0
GRN_CLS_CR_DEPO_SHEAR	1.0	0.5	0.2
GRN_CLS_ERO_RAT_CONS	1.0	0.001	0.001
LINK	1		
BEDLAYER_THIC	1.0	0.0	
BEDLAYER_GRAIN_DIS	1	0	0
POROSITY_LAYER	0.4	0.4	
CR_SHE_ERO_LAYER	1.0	1.0	
ERO_RAT_CONST_LAYER	0.002	0.002	
ERO_RAT_EXP_LAYER	1	1	
LINK	2		
BEDLAYER_THIC	1.0	0.0	
BEDLAYER_GRAIN_DIS	1	0	0
POROSITY_LAYER	0.4	0.4	
CR_SHE_ERO_LAYER	1.0	1.0	
ERO_RAT_CONST_LAYER	0.002	0.002	
ERO_RAT_EXP_LAYER	1	1	

In the above input table, following are the definitions of the input cards:

'GSSHASEDLIBFILE' card is for the GSSHA code to understand that it is a SEDLIB input file.

'GRN_CLS_NUM' card is for the total number of sediment grain classes.

'NUM_BED_LAYERS' card is for the total number of bed layers.

'GRN_CLS_DIA' card is for the diameter of each grain class (in meters).

'GRN_CLS_SET_VEL' card assigns a settling velocity for each grain class (meters per second).

'GRN_CLS_SPGRAV' card assigns a specific gravity for each grain class.

'GRN_CLS_PORO' card assigns a bed porosity for each grain class.

'GRN_CLS_CR_EROSION_SHEAR' is the critical erosion shear stress (in Pascal) for fresh cohesive sediment beds associated with each grain class.

'GRN_CLS_CR_DEPO_SHEAR' is the critical deposition shear stress for each grain class below which the particle deposition takes place (in Pascal).

'GRN_CLS_ERO_RAT_CONS' is the erosion rate constant for cohesive sediment erosion of fresh deposits (in kg/m²/s).

'LINK' card is used to define the channel link number.

'BEDLAYER_THIC' card is used to define the thickness of existing channel bed layers (in meters).

'BEDLAYER_GRAIN_DIS' card is used to define the bed layer grain class distribution.

'POROSITY_LAYER' card is used to define the porosity of each layer.

'CR_SHE_ERO_LAYER' is the critical erosion shear stress (in Pascal) for each existing bed layer.

'ERO_RAT_CONST_LAYER' is the erosion rate constant for cohesive sediment erosion for each existing bed layer (in $\text{kg/m}^2/\text{s}$).

'ERO_RAT_CONST_LAYER' is the erosion rate exponent for cohesive sediment erosion for each existing bed layer.

4 Save and Run the Model

gssha.exe with_instream_sed.prj