

# **Morpho2DH ver.2**

# Tutorial - Debris/Mud flow -

Produced by Hiroshi Takebayashi

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# I. Outline

# I.1 Morpho2DH

Morpho2DH is a calculation solver that a debris/mud flow model is added to Morpho2D.

Morpho2D is the unsteady horizontal two dimensional bed deformation analysis solver of bed material load, which is developed by Hiroshi Takebayashi, Kyoto University. The governing equations are written in boundary fitted general coordinate system. In 2009, the solver was installed to RIC-Nays Version 1.0 which is the free software developed by RIC. Some functions are added to the original version and the improved version is installed into iRIC Version2.0 on March 2011. On March 2014, Morpho2D was unified with Nays2D and Nays2DH was developed.

Morpho2DH is the horizontal two dimensional debris/mud flow analysis solver which can reproduce the transport and deposition process of debris/mud flow due to the landslides. Structures (ex. sabo dam, weir, house and so on) and horizontal distribution of maximum erosion depth can be considered in the analysis.

The unsteady horizontal two dimensional bed deformation analysis of bed material load which can be performed as it used to be.

# I.2 Morpho2DH Tutorial – Debris/Mud flow –

The purpose of the tutorial is to show the detailed procedure of the analysis from the beginning to end. Tutorials has enough explanations to perform analysis. However, if you cannot understand the tutorials, please refer iRIC user manual and Morpho2DH manual.

[Contents of Tutorial]

- Chapter II Transport and deposition process of debris/mud flow
- Chapter III Debris/Mud flow analysis with structures

# I.3 Open Morpho2DH

1. Startup iRIC, Select [Create New Project] from [iRIC Start Page].



Figure I-1(1) Start of iRIC

2. Select [Morpho2DH] in [Select Solver] window and press [OK].

C Select Solver		? ×
Select Solver     When you create a new pi EvaTRIP Pro     RITER Xsec     Fbml_flow3_v2023_2_iri     Mflow_02 iRIC4 ver1.1     Culvert Analysis Progra Boussinesq2D Tracer M     FaSTMECH     CERI1D     Morpho2DH v2.1     DHABSIM 12	roject, you have to select the solver to use for calculation. Please select a solver, and press "OK" butto Basic Information Name Morpho2DH v2.1 Version 2.1 23062305 Copyright Hiroshi Takebayashi Release 2014/11/01 Release 2014/11/01 Description License Description	? X
Nays2d+ River2D 1.0 Nays2DH IRC4x 1.0 64 Nays2DV retrical 2D mi nays3Dv 3D Density Fic NaysDw2(simple 2D D NaysCW2(simple 2D D	OK	Cancel
F	igure $I = 1(2)$ Selection of Morpho2DH	CarloBI

# II. Transport and deposition process of debris/mud flow

# Purpose

The purpose of this chapter is for researchers, river engineers and university students who have no (or a few) experience of transport and deposition process of debris/mud flow analysis to learn to perform debris/mud flow analysis by use of Morpho2DH and visualize the calculated results.

# Procedure

Procedure in this chapter is shown in Figure II - 1.



Figure II-1 Procedure in this chapter

# II.1 Grid generation from DEM data

# II.1.1 Load DEM data

### ■Setting of coordinate system

1. Click [Property	/] in [File].
Chips Lanc - RC wil (Sevens) 4 LL2705 Margin-2014 v.2.1 Pin-sin The Import Grographic Data Gnd Massand Values Calculation Chief Physic	Scenargo Windowi a Condition Simulation Calculation Final View Option Help $f_{\chi} \leftrightarrow \Rightarrow \uparrow \Rightarrow \bigcirc \bigcirc \bigcirc \bigcirc \checkmark \blacksquare \bigcirc 2 \  \  \square \  \  \square \  \square \  \square \  \square \  \square$
Control and CoSS file.      Serve Sequence Control Control Control      Consol Sequence Control      Control Control      Control Control      Control Control      Control Control      Control	
the Markoy Store the Markoy Store the Markoy Store the Markow Store	
	Scale: 1 / 5195         Angle: 0         Size: 1442 x 921         X:         V:         CS: EPSG2448: JGD2000 / Japan Plane Rectangular CS VI

Figure II-2(1) Open [Property] window

2. When the coordinate system is not specified yet, [Project property] dialog box is popped up. Please click [Edit] in [Coordinate System].

😫 Project Property		?	×
Basic Information			
Filename:	(No data)		
Last update time:	(Not saved yet)		
Solver:	Morpho2DH v2.1 version 2.1.230623	05	
Grid(s):	Setup unfinished		
Calculation condition:	Not set yet		
Calculation result:	No data		
Coordinate System:	(Not specified) Edit		
Coordinate Offset:	(0, 0) Edit		
Date for t = 0:	(Not specified) : SS sec Edit		
Output Setting	Output calculation results in sepa	arate file	s
		Close	

Figure II -4(2) Specify the coordinate system

<ol> <li>Target area is the river basin located north of Kyoto University of the Arts in Sakyoku Kyoto City, Japan. Hence, the coordinate system [EPSG2448:JGD2000/Japan Plan Rectangular CS VI] must be selected. Please click [OK].</li> </ol>
R Select Coordinate System
Search: japan
(Not Specified) EPSG:2443: JGD2000 / Japan Plane Rectangular CS I EPSG:2444: JGD2000 / Japan Plane Rectangular CS II EPSG:2445: JGD2000 / Japan Plane Rectangular CS III EPSG:2446: JGD2000 / Japan Plane Rectangular CS IV EPSG:2447: JGD2000 / Japan Plane Rectangular CS V EPSG:2448: JGD2000 / Japan Plane Rectangular CS VI EPSG:2449: JGD2000 / Japan Plane Rectangular CS VII EPSG:2450: JGD2000 / Japan Plane Rectangular CS VIII EPSG:2450: JGD2000 / Japan Plane Rectangular CS VIII EPSG:2451: JGD2000 / Japan Plane Rectangular CS XIII EPSG:2452: JGD2000 / Japan Plane Rectangular CS XI EPSG:2453: JGD2000 / Japan Plane Rectangular CS XII EPSG:2454: JGD2000 / Japan Plane Rectangular CS XIII EPSG:2455: JGD2000 / Japan Plane Rectangular CS XIII EPSG:2456: JGD2000 / Japan Plane Rectangular CS XIV
OK Cancel
Figure 11-2(3) Selection of coordinate system
4. Please confirm if the coordinate system is set or not in the [Project Property] window an press [Close].
Project Property ? X
Basic Information
Filename:(No data)Last update time:(Not saved yet)Solver:Morpho2DH v2.1 version 2.1.23062305Grid(s):Setup unfinishedCalculation condition:Not set yetCalculation result:No dataCoordinate System:EPSG:2448: JGD2000 / Japan Plane Rectangular CS VICoordinate Offset:(0, 0)

Figure II-4(4) Setting of coordinate system

Close

DEM data can be loaded from the web or from a file prepared in advance.



Figure II-3(5) Load DEM data

6. [Select Region] window will be opened. Move to the target area using [Zoom In] and [Zoom Out]. Background image can be selected from the [Background image] pulldown.



7. After movement to the target area (circled in red), click the left mouse button to specify one of the corners of the DEM data acquisition area, and then click the diagonal corner of the previously specified corner to set the DEM data acquisition area. After setting the DEM data acquisition area, click [Next].



area

8. [Zoom Level Setting] window is opened and select DEM data [国土地理院標高タイル(基盤 地図情報数値標高モデル DEM5A)].



9. DEM data is displayed.



Figure II-4(9) Display of DEM data



Figure II-4(10) Load the land elevation data

11. Load [Id	chijo.txt].				
💦 Select file to import				×	
$\leftrightarrow$ $\rightarrow$ $\checkmark$ $\uparrow$	・ デスクトップ > iRICMorpho2DH		✓ C iRICMorpho2DHの検索	م	
整理▼ 新しいフォルダー			□ ·		
<ul> <li>&gt; ● OneDrive - Persona</li> <li>■ デスクトップ</li> <li>↓ ダウンロード</li> <li>■ ドキュメント</li> <li>■ ビクチャ</li> <li>④ ミュージック</li> <li>■ ビデオ</li> <li>■ Asahi</li> </ul>	I Ichijo.txt				<b>XDEM data file</b> DEM data file is composed of the data number, x and y coordinate, land elevation data (z). Format of DEM data file is explained in iRIC manual.
ファイルキ	名(N):		<ul><li>✓ All importable files (*.tp 開く(O) キ</li></ul>	00 *.csv * ~ Fヤンセル	
Figur	e II-4(11)	Load the land	elevation data		

12. [Import Setting] window is opened. [CSV (Comma separated values] in [File Format] is checked and [X: field2, Y: field3, Z: field4] in [Select field] is set and press [OK].

ile name: C:¥U	lsers¥hiroshi¥Desktop¥iRIC	Morpho2DH¥Ichijo.txt			
ncoding:	System	~	Prev	/iew	
oordinate Sys	em EPSG:2448: JGD2000	/ Japan Plane Rectangular CS VI	Edit	field1	field2
File Format			1	0	32345.5860
🖸 CSV (Con	ima separated values)	Custom delimited text	2	1	32350.6870
Delimiters			3	2	32355.7880
Comma 🛛	_ Tab _ Space _ Colo	on 🔄 Semicolon 🔄 Other	4	3	32360.8880
Special charac	sters	<b>•</b> • • • •	5	4	32365.9890
Quote charac	ter:	Y Escape character: ¥	6	5	32371.0890
Record option Header lines f	n ignore 0 🖨 🗌 First I	neader line contains field names	7	6	32376.1900
Select fields -			8	7	32381.2910
X: field2	Y: field3	Value: field4	✓	8	32386.3910
Skip setting			10	9	32391.4920
Skip rate: 1	÷ 🕜		11	10	32396.5930

Figure II-4(12) Load the land elevation data



Background image can be loaded from the web or from a file prepared in advance.

### ■ To load Background image form the web

1. If [Coordinate System] is set, the background image is displayed by checking on the background image (国土地理院 (標準地図) in the following image) you want to display from [Background Image (Internet)]. To set the [Coordinate System], select [File]-[Properties], and then refer to [Figure II-2(1)]-[Figure II-2(4)].



### **%**Background image

When users create the numerical grids, background images help to identify the location and shape of houses and erosion control structures such as sabo dams or weirs.

# <complex-block><section-header>

Figure II-3(2) Load the background image



Figure II-3(4) Fit the background image

# II.1.2 Grid generation

1.

### Selection of the grid generation algorithm

 Note: Service: Service:

Click [Select Algorithm to Create Grid] in [Grid].

Figure II-4(1) Selection of the grid generation algorithm

Select [Create grid from polygonal line and width] in [Algorithm] and press [OK].
 A small window on information on grid generation algorithm is popped up and press [OK].

Select Grid Creating Algorithm		?	×
lgorithm:	Description:		
Treate grid from polygonal line and wid Treate grid from cross-section data Treate grid by dividing rectangular regic Treate grid by dividing rectangular regic Treate compound channel grid Treate grid shape solving Poisson equati General purpose grid generation tool J-shape channel generator Sample GridGenerator 2d arc grid generator	First, please define polygonal line, clicking. The polygonal line is used line of the grid. Then, you define t division number of grid in I directio direction.	by mouse l as the c he width, n and J	- enter

Figure II-4(2) Selection of the grid generation algorithm



Figure II-4(3) Information on grid generation algorithm

### Decision of number and size of grids

- 1 Click the upstream and the downstream ends of calculation region and press return key to decide the centerline of the calculation domain.
- 2 [Grid Creation] dialog box is popped up. Enter the number of longitudinal grids (**n**<sub>I</sub>), the number of transverse grids (**n**<sub>J</sub>), the width of calculation domain (**W**). The size of grids (**d**<sub>I</sub>, **d**<sub>J</sub>) are automatically calculated.
  3 Press OK in the dialog box.



Figure II-4(4) Decide the centerline of the calculation domain



calculation domain.





Figure II-4(7) Add division points in transvers direction

### Maximum erosion depth of land surface

1 Click [MaxErosionDepth] in [Object Browser] by right button and select [Add] and [Polygon].



Figure II-5(2) Creation method of polygon

2 Make a polygon by clicking at the corners of the polygon. The polygon should cover the whole calculation area. Double clicks stop to make the polygon.





Figure II-5(4) Input the maximum erosion depth



### ■Location and size of landslides

1 Click [Landslide] in [Object Browser] by right button and select [Add] and [Polygon].



2 Make a polygon by clicking at the corners of the polygon. The horizontal shape of the polygon should be the same as the horizontal shape of the landslide. Double clicks stop to make the polygon.



Figure II-6(2) Create a polygon

3	Enter	c the	landslide	depth	and	press	[OK]	in	the	small	dialog	boxes.
		🦯 Е	dit LandSli	de val	ue	?		Х				
		Plea	se input ne	w valu	e in	this po	lygon	1.				
			LandSlide	e : <u>1 </u>							Unit is	s m.
				ОК		) 💿	ance	I	)			
	F	igure	II - 6(3)	Input	t th	e land	slide	dep	oth			

Figure II-6(4) Create polygon

### Mapping



Figure II-7(2) Selection of valuables which need to be mapped



3 Check on each of the [Node attributes] in the [Object Browser]-[Grid] to see if the data is mapped to the grids (whether the grids are given values or not) (in the figure below, [Grid Creating Condition] is checked off to make it easier to see the color contours)..



Figure II - 7(4) Confirmation of mapping

# II.2 Setting of calculation conditions

# II.2.1 Setting of calculation conditions



Figure II-8(1) Setting of calculation conditions

### Setting of calculation parameters

1	Click [Parameters] in [Calculation Condition] dialog box.
2	Select [Debris/Mud Flow] in [Calculation Type].
3	[Start Time (s)] is 0.
4	[End Time (s)] is 300 (s).
5	[Computational Time Step (s)] is 0.01 (s).
6	[Output Time Step for File (s)] is 1 (s).
7	[Output Time Step for Screen (s)] is 1 (s).
8	[Start Time of Bed Deformation (s)] is 0 (s).

R Calculation Conditior	1		?	×
Groups Boundary Condit Calculation Type Calculation Con Calculation Con Bed Material Vegetation Obstacle Building Hot Start	Calculation Type Start Time (s) End Time (s) Computational Time Step (s) Output Time Step for File (s) Output Time Step for Screen (s) Bed Deformation Start Time (s)	Debris/1	/lud Flow :	0 300 0.01 1 0
Reset		ОК	Ca	ncel

Figure II-8(2) Setting of calculation parameters

Select [Debris/Mud flow] for bed deformation analysis by debris/mud flow. [Flow only] is for flow calculation. [Bed material load] is for bed deformation analysis by bed material load.

Start time of the calculation is set in [Start Time (s)]. Unit is second.

End time of the calculation is set in [End Time (s)]. Unit is second.

Time step  $\Delta t$  is set in [Computational Time Step (s)]. Unit is second. The time step is decided considering CFL condition. Output time step for file is set

Output time step for file is set in [Output Time Step for File (s)]. Short time step makes a smooth animation. Unit is second.

Output Time Step of calculation condition for Screen is set in [Output Time Step for Screen (s)]. Unit is second.

Start time of bed deformation is set in [Start Time of Bed Deformation (s)]. Unit is second. When the debris/mud flow calculation is performed, please input 0.

### Setting of calculation conditions

- 1 Open [Calculation Conditions (Debris/Mud Flow)] dialog box.
- 2 Select [Change] in [Sediment Concentration].
- 3 Input 1 for [Original Liquid Density].
- 4 Input 2.65 for [Sediment Density].
- 5 Input 0.6 for [Static Deposition Sediment Concentration].
- 6 Input 0.2 for [Liquid Behavior Sediment Ratio].
- 7 Input 0.01 (m) for [Minimum Flow Depth].
- 8 Input 34 (degree) for [Internal Friction Angle].
- 9 Select [Constant] in [Laminar Flow Depth], because spatial change of land slope is not changed well here.
- 10 Input 0.4 for [Laminar Flow Depth Ratio].
- 11 Input [Resistance Coefficient]. The value is about 72.
- 12 Select [Disabled] in [Fixed Bed Elevation].

Groups		
Boundary Conditio	Sediment Concentration	Change 🗸
Calculation Type a	Sediment Concentration Value	0.4
Calculation Condit	Original Liquid Density	1
Bed Material	Sediment Density	2.65
Vegetation	Static Deposition Sediment Concentration	0.6
Building	Liquid Behavior Sediment Ratio	0.2
Hot Start	Minimum Flow Depth (m)	0.01
	Internal Friction Angle (degree)	34
	Laminar Flow Depth	Constant \vee
	Laminar Flow Depth Ratio	0.4
	Resistance Coefficient	72
	Fixed Bed Elevation	Disabled $$

Figure  $\Pi = 8(3)$  Setting of calculation conditions

Please select [Change] when you want to consider the spatiotemporal change of sediment concentration.

The original liquid here is water and 1 is used in [Original Liquid Density].

[Sediment Density] is 2.65 here.

Static deposition sediment concentration is between 0.54 and 0.8.

Fine material behaves as liquid phase. Content rate of 0.2mm and finer diameter is rough standard to decide [Liquid Behavior Sediment Ratio].

[Minimum Flow Depth] must be set to get stable calculation results. The unit is m.

When the flow is debris flow, the laminar flow depth ratio is about 1. When the fine material includes in the flow well and turbulence flow layer is formed on the laminar flow layer, the laminar flow depth ratio must be smaller than 1. Value of [Resistance]

Coefficient] must be set to reproduce flow depth.

When some parts of the bed composed of rock or sabo dams is set in the calculation area, please select [Enable] in [Fixed Bed Elevation]. When [Fixed Bed Elevation] is [Enable], the fixed bed area must be set using polygons.

### Setting of bed material conditions

- 1 Click [Bed Material] in [Calculation Condition] dialog box.
- 2 Select [Uniform] in [Bed Material Type].
- 3 [Mean Grain Diameter (m)] is available, when [Uniform] is selected in [Bed Material Type]. Here, please input 0.01 (m).
- 4 Press [OK] to complete setting of calculation conditions.

R Calculation Condition		? ×	
Groups Boundary Conditio Calculation Type a Calculation Condit Calculation Condit Bed Material Vegetation Obstacle Building Hot Start	Bed Material Type Mean Grain Diameter (m) Grain Size Distribution Exchange Layer Thickness (m) Number Of Deposition Layer Initial Layer Number	Uniform 0.01 Edit 0.3 25 \$ 15 \$	Input mean grain diameter in [Mean Grain Diameter (m)]. This function is available only for uniform sediment
Reset	l) Setting of bed mate	OK Cancel	

■[Vegetation], [Obstructions], [Building], and [Hot Start] are not set here.

# II.2.2 Run the calculation

### Run the calculation



4	[Save iRIC	c project	file]	dialog	box	is	popped	up.	Input	file	name	and	press
	[Save].												

C Save iRIC project file						×
$\leftarrow \rightarrow \checkmark \uparrow$	> デスクトップ	> iRICMorpho2DH		~ C	iRICMorpho2DHの検	索 <b>ዖ</b>
整理▼ 新しいフォルダー						□ • <b>(</b> )
<ul> <li>N ギャラリー</li> <li>OneDrive - Personal</li> </ul>	I					
🛄 デスクトップ	*	Ichijo1.ipro				
↓ ダウンロード	*					
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🔀 ピクチャ	*					
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ファイルの種類(T): iRIC pro	ject file (*.ip	ro)				· · · · · · · · · · · · · · · · · · ·
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	Γ:		0		<b>*</b>	

### 5 Startup the gray colored screen automatically. 💦 Ichijo1.ipro - iRIC v4 (develop) 4.1.0.7025 [Morpho2DH v2.1] - [Solver Console [Morpho2DH v2.1] (running)] File Import Calculation Condition Simulation Calculation Result View Option Help Loading initial condition ..... Start! (^o^)/ 20 Morpho2DH Ver.1 1.0000000 s 300.0000000 s Present calculation time = = End time Time step of flow = 0.0100000 s ※ Information on the Type of calculation: Debris/Mud flow Vegetation density data: Not in use Vegetation height data: Not in use Rigid bed height data: In use screen Present calculation time (s) End time (s) Time step of flow (s) Type of calculation, Morpho2DH Ver.1 Use/No Use of Vegetation density data, Vegetation height Figure II - 9(5) Information of the run on the screen data, Rigid bed height data

6 When you want to check the calculation results during the run, please press 5 button. The method to visualize the calculation results is explained in the next section.

<b>.</b> .									
	Import Calculation Condition Simulation Calculation Re-	ner conson	Option Help	stobbeall			_		
	H 🖲 🗨 🛇 🖙 🖓 🖾 🗠 Y <sub>X</sub> Z	, Z <sub>X</sub>   4	$\rightarrow \uparrow \downarrow$	0 O	▶ 🔳 🦯 🖿	20 20 30	C) h		
\$	End time Time step of flow	2	300.0000000 s						1
4	Type of calculation: Debris/Mud flow Wegetation density data: Not in use Wegetation height data: Not in use Rigid bed height data: Not in use								
	Morpho2DH Ver.1								
	Present calculation time End time Time step of flow	3	148.0000000 s 300.0000000 s 0.0100000 s						
	Type of calculation: Debris/Mud flow Vegetation density data: Not in use Vegetation height data: Not in use Rigid bed height data: Not in use								
	Morpho2DH Ver.1								
	Present calculation time End time Time step of flow	5	149.0000000 s 300.0000000 s 0.0100000 s						
	Type of calculation: Debris/Mud flow Vegetation density data: Not in use Vegetation height data: Not in use Rigid bed height data: Not in use								
	Morpho2DH Ver.1								
	Present calculation time End time Time step of flow	-	150.0000000 a 300.0000000 a 0.0100000 a						
	Type of calculation: Debris/Mud flow Vegetation density data: Not in use Vegetation height data: Not in use Rigid bed height data: Not in use								
	Morpho2DH Ver.1								

Figure II-9(6) Load the calculation results

7 When [Solver Finished] dialog box is popped up on the screen, press OK. Solver Finished × i The solver finished calculation. OK

Figure II-9(7) Calculation is finished

# II.3 Visualization of calculation results

# II.3.1 Visualization of calculation results

1	Click 2D	but	ton.								
1											
R kd	hijo1.jpro - iRIC v4 (develop) 4.1.0.7025 [Morpho2DH v2.1] - [	Solver Conso	ie [Morpho2DH v2.1] (stopped)]					- D X			
E File	Import Calculation Condition Simulation Calculation	Result View	r Option Help		-			. 0	ж		
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,&	End time Time step of flow	-	300.0000000 s 0.0100000 s		<u> </u>				1		
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	Morpho2DH Ver.1										
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	Type of calculation: Debris/Mud flow Wegetation density data: Not in use Wegetation height data: Not in use Rigid bed height data: Not in use										
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	Present calculation time End time Time step of flow	÷	149.0000000 s 300.0000000 s 0.0100000 s								
	Type of calculation: Debris/Mud flow Vegetation density data: Not in use Vegetation height data: Not in use Rigid bed height data: Not in use										
	Morpho2DH Ver.1										
	Present calculation time End time Time step of flow	÷	150.0000000 * 300.0000000 s 0.0100000 s								
	Type of calculation: Debris/Mud flow Vegetation density data: Not in use Vegetation height data: Not in use Rigid bed height data: Not in use										
	Morpho2DH Ver.1										
			Carles	Anatas	Ciana 4002 - 024	N.	- Iu	and the Restored of Cold			

Figure II-10(1) Open visualization window

### ■Contour





Figure II-10 (2) Make contour of flow depth

- 2 When you want to modify the format of the contour, please open [Property] by clicking [Scalar] by the right button.
- 3 If you want to visualize the flow region only, the value about 0 is inputted in [Min] in [Value range] and check off [Fill lower area].
- 4 Modification of labels in the color bar can be made in [Color Bar Setting].



Figure II-10 (3) Select Property

) :	itionship between Automatically adju Setup Manually	values and colors ist based on value range	Value Range Automatic Max: 2.5 Min: 0	Color Bar Setting           Visible           Direction:         O Horizontal
o la	Value	Color	Add	Title
1	2.5	Color	Remove	Font Setting: Century Goth
2	1.875		Reverse Colors	Label Display
3	1.25		Equal Division	Format: %5.2f
4	0.625		Change Num. Colors	Number of labels: 🗹 Auto 💈 🌲
5	0			Font Setting: Century Go
				Color
ור	Fill lower area 🗸	Fill upper area		Title:
vito	ch to Discrete Mo	de		Label:
Im	port Exp	ort		
Irav	v contour lines	Line width: 1 🌻 px 🤇	Use values of colormap 🔘 Spe	cify division number 10 🌩

Figure II-10 (4) Modification of contour

5 Check on [Background Images] in [Object Browser].6 By using animation tool bar, calculation results can be checked as a movie.



Figure II-10 (5) Confirmation of the modification

# III. Debris/Mud flow analysis with structures

## Purpose

The purpose of this chapter is for researchers, river engineers and university students who have no (or a few) experience of transport and deposition process of debris/mud flow analysis to learn to perform debris/mud flow analysis with structures (sabo dam, weir, and so on) by use of Morpho2DH and visualize the calculated results.

# Procedure

Procedure in this chapter is shown in Figure II-1.



Figure III - 1 Procedure in this chapter

# III.1 Setting of fixed bed elevation (sabo dam, and so on)

# III.1.1 Setting of fixed bed elevation (sabo dam, and so on)

### Setting of sabo dam

1 Click [FixedBedElevation] in [Object Browser] by right button and select [Add] and [Polygon].



Figure III - 2(1) Create polygon

2 Make a polygon by clicking at the corners of the polygon. The horizontal shape of the polygon should be the same as the horizontal shape of the sabo dam. Double clicks stop to make the polygon.



Figure III-2(2) Create polygon

3	Enter the surface elevation of sabo dam in the bed level immediately upstream of the sabo dar 112 m was entered assuming an approximately 5 m	small dialog box. (Here, the m is approximately 107 m, so high sabo dam.)
	Edit FixedBedElevation value	
	Please input new value in this polygon.	
	FixedBedElevation : 112	Unit is m.
	OK Cancel	

Figure III-2(3) Input the surface elevation of sabo dam



Figure III - 2(4) Create polygon

4 The reference elevation for the [FixedBedElevation] can be either the ground surface or the same reference elevation as the ground elevation data. Right-click the name of the polygon created as [FixedBedElevation] in the [Object Browser] and click [Copy].



### %Fixed bed elevation and fixed bed elevation condition

User can select the reference elevation for the [FixedBedElevation] from either the ground surface or the same reference elevation as the ground elevation data.

When [FixedBedElevationP] is not specified, the same reference elevation as the ground elevation data is used as the reference elevation for the [FixedBedElevation]

Figure III - 2(5) Copy of the fixed bed elevation polygon

5 Select [FixedBedElevationP] as the destination of the copy.

🥕 Select Geogra	ohic Data		?		×
Please select whic	h geographi	c data to copy	y thi	is poly	/gon.
Elevation					$\sim$
Elevation Roughness FixedBedElevation VegetationDensity VegetationHeight Obstacle	P /				
LandSlide LandSlideTime MaxErosionDepth SurfaceSediment2				11	I
Figure Ⅲ-2(6)	Select the	destination	0†	the c	ору

6 Input [1], because the same reference elevation as the ground elevation data is used as the reference elevation for the [FixedBedElevation] here.

🥕 Copy Setting		?	×					
Please specify values	Please specify values for copied data.							
◯ Forall 0								
🔾 For each								
Name	<sup>-</sup> ixedBedElevatior	ixedBed	Elevati					
1 Polygon1	112	1						
	ОК	Can	cel					

# %Fixed bed elevation condition

When the same reference elevation as the ground elevation data is used as the reference elevation for the [FixedBedElevation], please input [1]. When the ground surface is used as the reference elevation for the [FixedBedElevation], please input [2].

Figure III-2(7) Input fixed bed elevation condition

# III.1.2 Setting of calculation conditions

### Enable of fixed bed elevation function [Calculation Click [Setting] in [Calculation Condition] and select 1 Conditions (Debris/Mud Flow)] dialog box. 2 Select [Enabled] in [Non-erodible Height]. Press [OK] and run the calculation. 3 R Calculation Condition ? $\times$

Groups		
Boundary Conditio	Sediment Concentration	Change 🗸
Calculation Type a	Sediment Concentration Value	0.4
Calculation Condit Calculation Condit	Original Liquid Density	1
Bed Material	Sediment Density	2.65
Vegetation	Static Deposition Sediment Concentration	0.6
Building	Liquid Behavior Sediment Ratio	0.2
Hot Start	Minimum Flow Depth (m)	0.01
	Internal Friction Angle (degree)	34
	Laminar Flow Depth	Constant \vee
	Laminar Flow Depth Ratio	0.4
	Resistance Coefficient	72
	Fixed Bed Elevation	Disabled \vee
		Enabled Disabled
Reset	OK	Cancel

Figure  $I\!I\!I\!-\!3$  Enable of fixed bed elevation function

# III.2 Visualization of calculation results

# III.2.1 Visualization of elevation change

### ■Contour





Figure Ⅲ-4 Contour of land elevation change