

Nays2D Flood Examples

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# Chapter 1 Using Nays2D Flood

This manual explains the basic operation and startup procedures of Nays2D Flood, which is compiled with iRIC. TheNays2D Flood solver simulates two-dimensional plane river flow and riverbed deformation. It was developed by Professor Yasuyuki Shimizu of Hokkaido University. The following explanation is based on the assumption that you have installed the iRIC software on your computer. If you have not installed the iRIC software, download it from the following URL and install it on your computer.

URL:http://i-ric.org/downloadSoftware:iRIC version4.0 or later

### **1.Nays2D Flood basic operating procedures**

The following are the basic procedures for operating Nays2D Flood with iRIC:

Launching Nays2D Flood Prepare to use Nays2D Flood on iRIC.

Creating the calculation grids

Create a grid for calculation using Digital Elevation Model (DEM) data or the like.

Setting the calculation conditions Set simulation discharge, boundary conditions, roughness and other items.

Making simulations Run Nays2D Flood for the simulation.

Visualizing the calculation results Visualize the simulation results, such as flow velocity, water depth and riverbed elevation, by means of a contour map/vector map to see whether the simulation has successfully run.

### 2. Launching Nays2D Flood

The following is the procedure to launch Nays2D Flood on iRIC.

When launching iRIC, the [iRIC Start Page] window will open. Click on [Create New Project] in the [iRIC Start Page] window.



The [Select Solver] window will open.

Select [Nays2D Flood v5.0] in the [Select Solver] window, and click on [OK].



A window with the title bar "Untitled-iRIC v4 [Nays2D Flood v5.0]" will appear.

V Initial - IRC v4.4.0.6884 (Nave2D Flood v5.0.64 bit) - (Pre-processing Window)	_	П	×
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🔨 🗸 🗹 🖿 Geographic Data			
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Nays2D Flood v5.0 is ready for use.

### **3. The sample data**

The sample data used for the sample simulations explained in this manual are available at:

URL: <u>http://i-ric.org/en/download</u> Examples of simulation: Nays2D Flood

To run Nays2D Flood according to this manual, data should be downloaded from the above site or provided by the staff in an iRIC training course.

The project files (\*.ipro) in the description and sample data of each chapter in this manual is created by following solver. Although the project file cannot be used without change if the solver version is different, resetting calculation conditions and so on, following this manual enables calculation with other versions.

Solver: Nays2D Flood v5.0

Data name	Contents	version
N2F	Examples of flood calculation for an	Nays2D Flood 5.0
	actual river section	
N2F_2	Examples of tsunami runup analysis	Nays2D Flood 5.0
	using SRTM data	
N2F_3	Examples of rainfall induced flooding in	Nays2D Flood 5.0
	actual river	

Sample data and corresponding solver version

### 4. Simulation conditions of Nays2D Flood

This manual teaches how Nays2D Flood is used to simulate river flow during flood events for two relatively simple examples. There are some omissions in the explanations of the physical and numerical aspects of the simulation conditions that are to be set. Nays2D Flood has other functions (setting conditions) in addition to those explained by this manual and these two specific examples. For more complete details, please refer to the Nays2D Flood Solver Manual.

# Chapter 2 Examples of flood calculation for an actual river section

#### Objectives

Simulate the flow regime (water depth and flow velocity) using Nays2D Flood for an actual river section with a flood discharge, and check to see whether the simulation is successfully run.

#### Outline

#### 1. Creating the calculation grid

Using elevation data of an actual river section, create a calculation grid.

#### 2.Setting the calculation conditions

Set flood discharge for unsteady flow. Set various other conditions necessary for simulation.

#### 3. Making a simulation

#### 4. Visualizing the calculation results

Here, we introduce how to display a water-depth contour map and a flow velocity vector map.

### **1. Creating the calculation grid**

**1** Importing cross-sectional river survey data

### **Importing geographic data**

On the menu bar, select [Import] - [Geographic Data] - [Elevation].



#### Open [¥¥SampleData¥¥N2F], select [N2F.tpo] and click on [Open].

Select file to import					×
← → × ↑ 📕 > PC	C > ボリューム (D:) > Sar	npleData > N2F	~ (	ッ / N2Fの検	索
整理▼ 新しいフォルダー					<b>■</b> • <b>■</b> ?
<ul> <li>&gt; PC</li> <li>&gt; 3D オブジェクト</li> <li>&gt; ダウンロード</li> <li>&gt; デスクトップ</li> <li>&gt; ドキュメント</li> <li>&gt; ビクチャ</li> <li>&gt; ビデオ</li> </ul>	N2Etpo	N2F_baktpo	Xa, qt1.csv	Xa, qt2.csv	Xa, qt3.csv
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こ Transcend (F:) イ ファイルネ	名(N): N2F.tpo			<ul> <li>✓ All importable</li> <li>開&lt;(O)</li> </ul>	e files (*.tpo *.csv <sup>-</sup> 〜 キャンセル

#### On the dialog [Filtering Setting], input [1] for [Filter] value and select [OK].

Set a larger number for the filter value and filter the dataset if the operation is slow because of the high number of data points. The filter simply skips over the data; i.e., if the filter is one, each data point is read into iRIC, but if the value is two, only every other data point is read in, and so forth.

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nco	ding: Sys	tem ~			
oord	dinate System	- Edit			
File	Format				
0	CSV (Comma separ	rated values) 🔘 (	Custom delimited text		
Del	imiters				
	Comma 🗌 Tab	Space 🗌 Col	on 🗌 Semicolon 🗌	Other	
Spe	cial characters				
Que	ote character: "		Bscape charact	er: ¥	0
Rec	cord options				
Hea	ader lines to ignore	1 🗘 🗌 First h	neader line contains fiel	d names	
Sel	ect fields				
X:	field1	Y: field2	~	Value: ficId3	~
0					
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Pre	41-1-14	field2	field3		^
Pre	Tield I				
Pre	25986.32917	-22007.12696	251.93		
Pre 1 2	25986.32917 12434.10425	-22007.12696	251.93 148.9586111		1
1 2 3	12434.10425 12686.09018	-22007.12696 -36164.71639 -36164.24332	251.93 148.9586111 150.9580556		1
Pre 1 2 3 4	125986.32917 12434.10425 12686.09018 12938.07611	-22007.12696 -36164.71639 -36164.24332 -36163.76076	251.93 148.9586111 150.9580556 154.9569444		
1 2 3 4 5	125986.32917 12434.10425 12686.09018 12938.07611 13190.06205	-22007.12696 -36164.71639 -36164.24332 -36163.76076 -36163.26872	251.93 148.9586111 150.9580556 154.9569444 158.9558333		
1 2 3 4 5 6	12434.10425 12686.09018 12938.07611 13190.06205 13442.04798	-22007.12696 -36164.71639 -36164.24332 -36163.76076 -36163.26872 -36162.76718	251.93 148.9586111 150.9580556 154.9569444 158.9558333 161.955		
1 2 3 4 5 6 7	125986.32917 12434.10425 12686.09018 12938.07611 13190.06205 13442.04798 13694.03392	-22007.12696 -36164.71639 -36164.24332 -36163.76076 -36163.26872 -36162.76718 -36162.25615	251.93 148.9586111 150.9580556 154.9569444 158.9558333 161.955 165.9538889		
1 2 3 4 5 6 7 8	neid1           25986.32917           12434.10425           12686.09018           12938.07611           13190.06205           13442.04798           13694.03392           13946.01986	-22007.12696 -36164.71639 -36164.24332 -36163.76076 -36163.26872 -36162.76718 -36162.25615 -36161.73562	251.93 148.9586111 150.9580556 154.9569444 158.9558333 161.955 165.9538889 173.9516667		×





### Importing a background image

On the menu bar, select [Import] - [Background Image].



Background image

When creating grids for calculation, importing background images such as maps and aerial photos makes it possible to create grids that incorporate riverbanks and land use. Obstacle cells and roughness cells mentioned below can be set in reference to the background image.

#### Open [¥¥SampleData¥¥N2F] and select [N2F.jpg].

🖟 Open Image file					×
	~ Ō	N2Fの検索			P
整理 ▼ 新しいフォルダー			▼ 3		?
<ul> <li>OneDrive</li> <li>PC</li> <li>3D オブジェ/</li> <li>ダウンロード</li> <li>アスクトッブ</li> <li>ドキュメント</li> <li>ビクチャ</li> <li>ビブオ</li> <li>ミュージック</li> <li>Windows (</li> <li>RECOVERY</li> </ul>					
→・・・ロ タ ファイル名( <u>N</u> ): N2F	~	All images(*.jp 開く( <u>O</u> )	g *.jpeg *	.png *.t ヤンセル	×

# Using the [Move], [Rotate] and [Zoom] functions, match the background image with the elevation data.



#### Referring to the hint above, match the background image with the elevation data.



Click on [Background Image]-[N2F.jpg] on the object browser.

Fix the background image with [fix position].



You can also set the position of the background image by right-clicking the object browser [Background Image]-[N2F.jpg] and specifying coordinates from [Properties].

R Background Image Position ? ×								
Method of designation Specify bottom-left vertex position, scale, and rotate angle Specify bottom-left and bottom-right vertex positions								
Bottom-left vertex Bottom-right vertex								
X:	100	)15.7000 🗣	X:	29	527.141	1		
Y:	-368	323.9000 韋	Y:	-36776.5991 🖨				
Scale:	Scale: 22.2734 🖨							
Rotate Angle: 🕐 0.1389 🚔								
Reset OK Cancel Apply								

### **2** Selecting an algorithm for creating a grid

On the menu bar, select [Grid] - [Select algorithm to create grid]. The [Select Grid Creating Algorithm] window will open.



Select [Create grid from polygonal line and width] from the list below the [Select Grid Creating Algorithm] window, and click on [OK].

Nays2D Flood primarily creates a grid from polygonal lines and grid widths.

C Select Grid Creating Algorithm		?	$\times$
Algorithm:	Description:		
Create grid from polygonal line and widt Create grid from cross-section data Create grid by dividing rectangular region Create grid by dividing rectangular region Create grid by dividing rectangular region Create grid shape solving Poisson equatic General purpose grid generation tool u-shape grid generator for Nays3dv 2d arc grid generator 2d arc grid generator (Compound Channe Grid Generator for Nays2Dv Grid Generator for Nays3Dv Multifunction Grid Genarator Simple Straight and Meandering Channel U-shape channel generator	First, please define polygonal line, by clicking. The polygonal line is used a line of the grid. Then, you define the division number of grid in I direction direction.	mouse s the ca width, and J	- enter
	ОК	Can	cel

### **3** Creating a grid

Right-click on several points through which the grid centerline passes, and press the

#### "Enter" key.



Set the grid centerline from the upstream end, where flood flow enters, to the downstream end, where the flood flow exits. To finish, doubleclick on the end of the centerline, or hit the "Enter" key.

#### In the [Grid Creation] window, make the following settings and click on [OK].



Number of divisions in the longitudinal direction : **63** Number of divisions in the transverse direction : **30** Grid width in the transverse direction : **6000 m** 

#### Click on [Yes] in the [Confirmation] window.



#### A grid will be created.



It is possible to move, add or remove centerline points under [Grid Creating Conditions] even after the grid is created.

### **2. Setting the calculation conditions**

### 8 **Open "Calculation Conditions"**

On the menu bar, select [Calculation Conditions] - [Setting].

The [Calculation Conditions] window will open.



### **9 Setting the inflow boundary conditions**

Click on [Inflow/ Outflow Boundary Conditions] from the [Groups] list to make the following settings:

Calculation Condition	n		?	×
Groups Inflow/Outflow Initial Water Sur Time Others	Time unit of discharge/water surface file Boundary Conditions for )=1 Boundary Conditions for )=nj Water surface at downstream Constant value (m) Stage at downstream time series Rainfall Rainfall time series(mm/h)	Free	Second Inflow Outflow outflow Edit Edit	> > > > > > 0 0
Reset	0	ĸ	Can	cel

Time unit of discharge/water surface elevation files: Second Boundary Conditions for j=1: Inflow Boundary Condition for j=nj: Outflow Water surface at downstream: Free Outflow Rainfall: without Note : Inflow conditions are decided at [6.Setting the inflow river conditions] Use constant value or read from file when the stage at downstream is effected by sea level or overflow level at the outflow.

### **10 Setting the initial water surface profile**

Click on [Initial Water Surface Elevation] from the [Group] list to make the following settings:

R Calculation Condition			?	×	<	
Groups Inflow/Outflow Initial Water Sur Time Others	Initial water surface Initial water surface slope of main channel	Depth =	<u>0</u> 0.	<b>v</b>		Initial water surface: Depth = 0 Note: When the water surface elevation of the downstream end may be affected by the sea level or the downstream flood level, use a constant value (a line).
Reset	C	ж	Ca	ncel		

## **11 Setting the time**

R Calculation Condition		? ×	
Groups Inflow/Outflow Boundar Initial Water Surface Time Others	Output time interval (sec) Calculation time step (sec) Start time of output (sec) Start time of bomber (sec)	600 02 0	Output time interval (sec): 600 Calculation time step (sec): 0.2 Start time of output (sec): 0 Start time of bomber (sec): 0
Reset		OK Cancel	

Click on [Time] from the [Group] list to make the following settings:

### **12 Other settings**



Click on [Other] from the [Group] list to make the following settings:

Many other conditions can be set; however, they do not need to be set for this simulation as the default values are acceptable. After making the settings above, click on [Save and Close] to close the window.

### **13 Setting inflow rivers**

Set the inflow rivers (or the bank opening point) at the upstream (red line) and right side (blue line) since you set the [boundary condition for j = 1] as [inflow] in the inflow/ outflow boundary conditions.



In this river section, two rivers (including agricultural canals) flow across the red line and one river flows across the blue line, as indicated by the red arrows. No river comes in the area from the outlet i=ni or the other bank j=nj and these boundary conditions are outflow only.

#### In the Object Browser, select [Boundary condition setting]-[Add inflow]



While selecting the [Inflow], enclose the sides of "Inflow" locations with polygons.

When the location is confirmed, the [Boundary condition] setting dialog opens.



🥕 Bounda	ary Condition ? $\times$	
Type:	Inflow	
Name:	New Inflow1	
Setting		
Discharg	e time series Edit	
Slope va	lue at inflow 0.001	Name: arbitrary name, we use New Inflow 1
Color:		Slope value at inflow: 0.001
🗹 Transp	arent 50 🖨	
Line Width	. 7 🔹	
🗹 Show r	name	
	OK Cancel	

	In the	[Boundar	v Condition]	, click on	Discharge	time series]
--	--------	----------	--------------	------------	-----------	--------------

A Boundary Condition ? X						
Type:	Inflow					
Name:	New Inflow1					
Setting						
Discharge time series Edit						
Slope value at inflow 0.001						
Color:						
🗹 Transparent 🗾 50 🖨						
Line Width: 7 🖨						
✓ Show name						
	OK Cancel					

#### In the [Calculation Condition], click on [Import]



In [Choose a text file] click on [qt1.csv] and then [open].

Open the discharge data.



#### Click on [OK].

Repeat above operations for New Inflow 2 to New Inflow 3.





#### Click on [Grid] on the menu bar [Attribute Mapping]-[Execute].

Position setting of inflow boundary condition

#### Inflow rivers are set on the sides.



#### **14 Setting roughness condition**





Right-click on the object browser [Geographic Data]-[Roughness condition] and click [Add]-[polygon].



Click on Object Browser[Geographic Data]-[Roughness condition]—[Polygon1]. Double-click the cell with the same roughness surrounded by polygons. In [Edit Roughness condition value], directly input the desired Manning roughness.



Roughness condition:0.03

Note: Set Manning's roughness coefficient by taking comprehensive consideration of calculation model, land use and past flooding data.

In setting the roughness coefficient, refer to page 33 of Flood Simulation Manual (draft) and page 89 of Hydraulic Formula 1999 Edition (both in Japanese).

Click on [Grid] on the menu bar - [Attribute Mapping]-[Execute].



Roughness is reflected in the cell.



#### **References:**

#### Extract from pp. 33 of

Flood Simulation Manual (Draft) – Guide for simulation and verification of new model, Urban River Research Lab, River Section, Public Works Research Institute (Japan), February 1996

- Find the area of each land use within each mesh. Land use: building; farmland A<sub>1</sub>, road A<sub>2</sub> and other land use A<sub>3</sub>. Here, "farmland" means rice paddy, upland field or orchard. "Road" includes sidewalks along the road. Wilderness, grass fields and wetlands are included in "other land use."
- 2) The roughness coefficients by land use are set as follows: The bottom roughness coefficient other than that of buildings is calculated from the following weighted average:

$$n_0^2 = \frac{n_1^2 A_1 + n_2^2 A_2 + n_3^2 A_3}{A_1 + A_2 + A_3}$$

where,  $n_1=0.060$ ,  $n_2=0.047$  and  $n_3=0.050$ .

3) The composite equivalent roughness coefficient of the land and buildings is given by the following equation:

$$n^2 = n_0^2 + 0.020 * \frac{\theta}{100 - \theta} * h^{4/3}$$

where,  $\theta$  is the proportion of land occupied by buildings and *h* is water depth.

### **15 Setting obstacle cells**

In the Object Browser, check [Grid]-[Cell attributes]-[Obstacle].



Right-click the object browser [Geographic Data]-[Obstacle] and click [Add]-[Polygon].



Click the object browser [Geographic Data]-[Obstacle]-[Polygon1]. Double-click a cell that will become an obstacle cell with polygons. In [Edit Obstacle value], select Obstacle.



Set obs tacles such as roads, banks and embankments.

Note: Unless the calculation grid cells are small enough to depict roads, banks and embankments as a part of the topography, set roads, banks and embankments as obstacles.

Click on [Grid]on the menu bar -[Attribute Mapping]-[Execute].



Obstacle is reflected in the cell.



Repeat above operations from Polygon1 to Polygon2.


# **16 Setting Areal fraction that buildings occupy**





Right-click the Object Browser [Geographic Data] - [Areal fraction that buildings occupy] and click [Add] - [Polygon].



Click the Object Browser [Geographic Data]-[Areal fraction that buildings occupy]-[Polygon1]. Double-click the cell with the same building occupancy surrounded by polygons.

In [Edit Areal fraction that buildings occupy value], enter directly the building occupancy fraction.



Building occupancy ratio: 0.3

Note: Resistance by buildings is based on the phenomenon that flow is affected by buildings and flooding occurs in buildings. For this reason, the premise differs from the abovementioned obstacle setting, so be careful.

If the areal fraction that buildings occupy is larger than 0.95, the model set the value to 0.95. Because this model is a model for permeable obstacles and can not consider completely impermeable obstacles.

When you want to put impermeable obstacles, please use [Obstacle cell].

#### Rest\_tmp1/pro-iRIC v4.4.0.0684 (Nays2D Rood v5.0 64 bit) File Import Geographic Data Grid Measured Values Calculation C Image: × $\begin{array}{c} & & \\ & &$ ng Window Pre-processing Words Pre-processing W Pre-p 2 Object Browser 1 Areal fraction th. Areal fraction th. Measured Values Measured Valu Areal fra tion 0.30 0.22 0.15 0.07 000

Click the menu bar [Grid]-[Attribute Mapping]-[Execute].

The building occupancy rate is reflected in the cell.



Set "inside" geometry of box culvert.

Click the Object Browser [Boundary Condition Setting]-[Add Box culvert].



Pass the water through the box culvert to the road set for the obstacle cell.

Note: The setting method of gate, pump is the same as the setting method of box culvert.

Click the Object Browser [Grid] – [Boundary Condition Setting] – [New Box Culvert]. Surround the cell at the "inlet" position of the box culvert with polygons.



In the figure on the left, the object browser [grid] -[cell attribute] - [obstacle cell] is checked so that the location of the obstacle cell can be seen on the figure.

### Double-click to confirm the position of "inside".

The boundary Condition screen is displayed.



Change the name on [Boundary Condition] screen to [new Box Culvert\_in] and set it as an inside.

Boundary Condition ?	×
Type: BoxCulvert	
Name: New BoxCulvert_in	
Setting	
Coupling code number	•
Inlet/Outlet Inlet	Name: arbitrary, we use New
Width(m)	1 Box Culvert_in
Height(m)	A couple of code number: 1
- Elevation(m) 14	Width(m): 1
	Height(m): 1
the reduct for more the	Elevation(m): 140
	Extended formula : No
pefficient of submerged flow 0.7	Coefficient of submerged flow:
oefficient of subsurface flow 0.5	
Coefficient of free flow 0.7	9 Note: Combine the code number
eler.	at inlet/outlet.
/ Transparent	
✓ Show name	
OK Cancel	

#### Set "Outside" of the Box culvert.

In the Object Browser, select [Boundary condition setting]-[Add Box Culvert]



Click the Object Browser [Boundary Condition Setting]-[New Box Culvert]. Enclose the cell at "outside" position of the box culvert with polygons.



### Double-click to set the position of "outside".

The Boundary Condition screen is displayed.



### Set the conditions of the box culvert from the dialog.

🥕 Boundary Condition	? ×
Type: BoxCulvert	
Name: New BoxCulvert_out	
Setting	
Coupling code number	1 🖨
Inlet/Outlet	Outlet $$
Width(m)	2
Height(m)	2
Elevation(m)	0
Multiply	1
Extended formula	No $\sim$
Coefficient of submerged flow	0.75
Coefficient of subsurface flow	0.51
Coefficient of free flow	0.79
Color: <b>Transparent</b> 50	D 单
Show name	
OK	Cancel





### On the menu bar, select [Grid] - [Attributes Mapping] - [Execute...]

The box culvert is set in the cell.



# **3.** Making a simulation

On the menu bar, select [Simulation] - [Run]. Save the project.



The [Solver Console [Nays2D Flood] (running)] window will open to start the simulation.



# 4. Visualizing the calculation results

## 8 Open the "2D Post-Processing" window

On the menu bar, select [Calculation Result] - [Open new 2D Post-Processing Window].

e Import Calo	ulation Condition	Simulation	Calculation Result View Option Help	
(3 💾 💽	<b>PO n</b>	$\sim$ O	🔽 Open new 2D Post-Processing Window	Á
2400.000	41.5750	0.0000	Gen new 2D Bird's-Eye Post-Processing Window	0
3000.000	58,1450	0.0000	Deen new 3D Post-Processing Window	
3600.000	66.4552	0.0000		
4200.000	74.3554	0.0000	🗠 Open new Graph Window	
4800.000	105.8555	0.0000	Tes Open new Scattered Chart Window	
5400.000	138.2257	0.0000		
6000.000	142.8413	0.0000	Q, Open new Ventication Window	
6600.000	137.6788	0.0000	(5 Reload	
7200.000	141.4244	0.0000		
7800.000	117.9624	0.0000	Delete	
9000.000	95 2586	0.0000	Manage cimple operation results	
9600.000	76 7353	0.0000	wanage simple operation results	
10200.000	71.6334	0.0000	F Import.	
10800.000	49.4765	0.0000		
11400.000	71.5822	0.0000	export.	
12000.000	125.1368	0.0000	Export solver console log	
12600.000	161.6364	0.0000		
13200.000	228.1167	0.0000	<ul> <li>Import Visualization/Graph Settings</li> </ul>	
13800.000	288.2414	0.0000	Export Visualization/Graph Settings	
14400.000	303.6077	0.0000		
15000.000	317.6178	0.0000	0.0000 out	
16200.000	415 1530	0.0000	0.0000 out	
16200.000	417 3801	0.0000	0.0000 out	
17400 000	432 9158	0.0000	0.0000 out	
18000.000	476.2572	0.0000	0.0000 out	
18600.000	465.8841	0.0000	0.0000 out	
19200.000	461.8154	0.0000	0.0000 out	
19800.000	432.8071	0.0000	0.0000 out	
20400.000	379.2430	0.0000	0.0000 out	
21000.000	341.3872	0.0000	0.0000 out	
21600.000	254.4899	0.0000	0.0000 out	
22200.000	200.1740	0.0000	0.0000 out	
22800.000	142.3362	0.0000	0.0000 out	
23400.000	43 9790	0.0000	0.0000 out	
24600.000	20 3657	0.0000	0.0000 out	
25200.000	12.4907	0.0000	0.0000 out	
Finish	0			
Calcuratio	n time 84.	00000	sec.	
Calcuratio	n time 1.4	00000	min.	
Calcuratio	n time 2.33	33333E-02	hour.	

The "Post-Processing (2D)" window will open.



# 9 Visualizable quantities

DESCRIPTIONS IN THE OBJECT	DESCRIPTION OF EACH QUANTITY				
BROWSER					
• CONTOUR					
DEPTH(MAX)	The max. water depth by the time of				
	visualization (m).				
DEPTH	The water depth at the time of visualization				
	(m)				
ELEVATION	The ground height of calculation grid (m)				
WATERSURFACEELEVATION	The water surface elevation at the time of				
	visualization (m)				
VELOCITY (MAGNITUDE MAX)	The max. flow velocity by the time of				
	visualization (m/s)				
VELOCITY (MAGNITUDE)	Flow velocity at the time of visualization				
	(m/s)				
• VECTOR					
VELOCITY	Vector of flow velocity $(m/s)$ at the time of				
	visualization				
• STREAMLINE					
VELOCITY	Displays a streamline.				
• PARTICLES					
VELOCITY	Displays particles.				
• CELL ATTRIBUTES					
OBSTACLE CELL (A NORMAL	IAL Displays a normal cell.				
CELL)					
OBSTACLE CELL (A CELL WITH	Displays an obstacle cell.				
AN OBSTACLE)					
BOMBER CELL (A NORMAL CELL)	Displays a normal cell.				
BOMBER CELL (A CELL WITH	Displays an bomber cell.				
ANBOMBER)					

## **10** Visualizing the max. water depth

In the Object Browser, select [Nays2D Flood Grids] - [iRICZone] – [Scalar] - [Depth (Max)].

A contour map of water depth will open.



In the Object Browser, select [Nays2D Flood Grids] - [iRIC Zone] - [Scalar]. Rightclick on [Depth(max)] to select [Property].



The [Contour Setting] window will open.

In the [Contour Setting] window, make the following settings and click on [OK].

Presets: [Please select II > ] tarone Color bar setting when importing Pelastonehip between values and colors Pelastonehip between val	Color Bar Setting Veibility Weibility When selected @ Always O Never Direction: Horizontal @ Vertical Title Title Title Title Cons Setting: MS UI Gothic 14 pt Edit Label Display Fornt Setting: MS UI Gothic 11 pt Edit Color Title: Label Background: Transparent	Value range : Remove ☑ from Automatic Max : 1 Min : 0.01 Colors : No change Remove ☑ from Fill lower are Transparent: No change Color Bar Setting: No change
Import Export		

#### The contour map is clear.



## **11** Visualizing the max. flow velocity

In the Object Browser, check [Nays2D Flood Grids] - [iRIC Zone] - [Scalar] - [Velocity (magnitude Max)].



Value range : Remove ☑ from Automatic Max : 2 Min : 0.01 Colors : No change Remove ☑ from Fill lower area Transparent: No change

Color Bar Setting: No change

## **12** Visualizing the inflow discharge hydrograph

#### Open [New Graph Window].



Calculation Result	1		?	×	
Point Data New BoxCulvert_in New BoxCulvert_out New Inflow1 New Inflow2 New Inflow3 Two dimensional Data Grid Location: Vertex  Depth(Max) Depth Elevation WaterSurfaceElevation Velocity (magnitude Max) IBC Velocity(ms-1) (magnitude)	Add >> << Remove	Selected Data			Unit: m³/s
		OK	Cano	el	

### [Data Source Setting] screen is displayed.

Select [Calculation Result] - [Point data] - [New Inflow1], [New Inflow2] and [New Inflow3] - [Add].

The hydrograph of the incoming river is displayed.



Select [Calculation Result] - [Point data] –[New Box Culvert\_in], [New Box Culvert\_out] - [Add].

The hydrograph of box culvert is displayed.



# Chapter 3 Examples of Tsunami Runup Analysis Using SRTM data

# Objectives

The objectives are to use Shuttle Radar Topography Mission (SRTM) data, to simulate and visualize the simulated flow regime, such as water surface elevation and flow velocity, at a river mouth when tsunami-runup-induced flooding occurs with Nays2D Flood.

## Outline

### 1. Creating the calculation grid

Using elevation data of an actual river basin, create calculation grids: 101 division points in the transverse direction, and 131 division points in the longitudinal direction.

### 2. Setting the calculation conditions

Set a value for tsunami wave height assuming that a large-scale earthquake has occurred. Set various other conditions necessary for simulation.

### 3. Making a simulation

### 4. Visualizing the calculation results

Here, we introduce how to display a waterdepth contour map and a flow velocity vector map.

# **1. Creating the calculation grid**

## 1 Importing geographic data

In the Object Browser, right-click [Geographic Data]-[Elevation].Click [Import Elevation from web].



[Select Coordinate System] screen is displayed. Search with JGD and select [EPSG:2452:JGD2000/Japan Plane Rectangular CS X].

🔁 Select Coordinate System	?	×
Search: jød		
(Not Specified)		^
EPSG:4612: JGD2000		
EPSG:6668: JGD2011		
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:2451: JGD2000 / Japan Plane Rectangular CS IX		
EPSG:2452: JGD2000 / Japan Plane Rectangular CS X		
EPSG:2453: JGD2000 / Japan Plane Rectangular CS XI		
EPSG:2454: JGD2000 / Japan Plane Rectangular CS XII		
EPSG:2455: JGD2000 / Japan Plane Rectangular CS XIII		
EPSG:2456: JGD2000 / Japan Plane Rectangular CS XIV		
EPSG:2457: JGD2000 / Japan Plane Rectangular CS XV		
EPSG:2458: JGD2000 / Japan Plane Rectangular CS XVI		
EPSG:2459: JGD2000 / Japan Plane Rectangular CS XVII		
EDSG-2460+ IGD2000 / Japan Diano Postangular CS XV/III		*
Hint about Japanese coordinate systems (EPS	<u>G:2443 -</u>	<u>2461)</u>
Hint about UTM coordinate systems (EPSG:32	<u>601 - 327</u>	60 etc.)
OK	Can	cel

The coordinate system of the target area can be understood from the hint on the coordinate system at the bottom of the screen.



### [Select Region] screen is displayed. Drag the target part and click [Next].

To enlarge or reduce the map, click [Zoom In] / [Zoom Out] at the bottom of the screen.

Zoom Level Setting] screen will be displayed. Specify the zoom level and select the source.

	🙋 Zoom Level	Setting		?	×	Zoom level : 11 Source : USGS (SRTM)
:	Specify the zoo Zoom level: Resolution: Data size:	m level of data you want to import. 11 🜲 59.1616 m 4 MB (1048576 points)				Note: Since the resolution of the SRTM data is 90 m mesh, even if the zoom level is set to 11 or more here, the
	Source:	USGS 標高タイル (SRTM)	OK	Canc	▼] el	data does not change because the maximum resolution has been reached. Therefore, the zoom level is set to 11.

Reading is successful if the shape of the watershed to be calculated is displayed on [Preprocessing Window] screen.



When one of the items in the background image of the object browser is checked, the background image is displayed.



Background image

When creating grids for calculation, importing background images such as maps and aerial photos makes it possible to create grids that incorporate riverbanks and land use. Obstacle cells and roughness cells mentioned below can be set in reference to the background image.

#### Since the coordinate system is selected, it is set automatically.



If your PC specifications are insufficient, you may not be able to process very large arrays of elevation data. To speed up processing, remove geographic data in the areas that are not needed.

Click on [Fit] to display the entire data. Select [Object Browser] - [Geographic data 1] and keep the data ([Geographic data 1]) selected. Select the area you wish to delete by dragging and right clicking. (The gray area in the figure below. An area slightly larger than the background image must remain). Delete the unnecessary areas by clicking [Delete selected points].

Repeat the above procedure. The area slightly larger than the background image will be left.



#### Tips:

In the event that the PC specifications are insufficient, you may not be able to process large numbers of elevation data.

To speed up processing, remove geographic data in the areas that are not needed.

Such removal is not necessary when your PC has specifications high enough to maintain stable operation even when large numbers of data are processed.

## **2** Selecting an algorithm for creating the grid

On the menu bar, select [Grid] - [Select algorithm to create grid]. The [Select Grid Creating Algorithm] window will be displayed.



Select [Create grid from polygonal line and width] from the list under the [Select Grid Creating Algorithm] window, and click on [OK].

尾 Select Grid Creating Algorithm ?  $\times$ Algorithm: Description: Create grid from polygonal line and widt First, please define polygonal line, by mouseclicking. The polygonal line is used as the center Create grid from cross-section data line of the grid. Then, you define the width, division number of grid in I direction and J Create grid by dividing rectangular region direction. Create grid by dividing rectangular region Create compound channel grid Create grid shape solving Poisson equation General purpose grid generation tool u-shape grid generator for Nays3dv 2d arc grid generator 2d arc grid generator (Compound Channe Grid Generator for Nays2Dv Grid Generator for Nays3Dv Multifunction Grid Genarator Simple Straight and Meandering Channel U-shape channel generator < > ΟK Cancel

Nays2D Flood generates a grid from polygonal lines and widths.

## **3** Creating a grid

Click on several points through which the grid centerline passes and press the Enter key on your keyboard to draw a centerline.



# Setting the grid centerline

Set the grid centerline from the upper reaches of the river (upstream) to the sea (downstream). To finish, press the Enter key or double click.

In the [Grid Creation] window, make the following settings and click on [OK].



[nj] (Number of divisions in the longitudinal direction): 100
[ni] (Number of divisions in the transverse direction): 130
[W] (Grid width): 3000 m
Note: In this example, grid cell intervals di, dj are set at around 30 m. Click on [Yes] in the [Confirmation] window.



#### A grid will be created.



Adjusting the calculation grid

It is possible to move, add or remove any vertexes by selecting the [Grid Creating Condition] even after the grid is created.

# **2. Setting the calculation conditions**

## **1** Open [Calculation Condition]

#### On the menu bar, select [Calculation Condition] - [Setting].

The [Calculation Condition] window will open.



# 2 Setting the inflow boundary conditions

Click on [Inflow Boundary Condition] from the [Group] list to make the following settings: Click on [Stage at downstream time series] to edit.

The [Calculation Condition] window will open.

R Calculation Conditio	n	? ×
Groups Inflow/Outflow Initial Water Sur Time Others	Time unit of discharge/water surface file Boundary Conditions for j=1 Boundary Conditions for j=nj Water surface at downstream Constant value (m) Stage at downstream time series Rainfall Rainfall time series(mm/h)	Second ~ Inflow ~ Outflow ~ Read from file ~ Edit without ~ Edit
Reset	C	K Cancel

[Time unit of discharge/water surface file]: Second

[Boundary Conditions for j=1]: Inflow

 $[Boundary \ Conditions \ for \ j=nj]: \ \underline{Outflow}$ 

[Water surface at downstream]: Read from the file

Rainfall: without

Note 1: Inflow boundary conditions are set at "6. Inflow Settings".

Note 2: When "Water surface elevation at downstream end" is affected by the sea surface level or flood water level of downstream, select [Constant value] or [Read from file].

#### Click on [Import] on the [Calculation condition] window.

The [Select text file] window will be displayed.



### Select [¥¥SampleData¥¥N2F\_2] - [H01.txt] and click on [Open].

Time series of tsunami wave height data is displayed.

Choose a text file				×
→ 👻 ↑ 📕 > PC	> ポリューム (D:) > SampleData > N2F_2	ٽ ×		
を理▼ 新しいフォルダー			₿== ▼	
> PC	名前	更新日時	種類	サイズ
🧊 3D オブジェクト	H01.txt	2020/09/29 14:49	テキスト ドキュメント	
🖊 ダウンロード	Q01.txt	2020/09/29 14:49	テキスト ドキュメント	
🔜 デスクトップ				
🗏 ドキュメント				
📰 ピクチャ				
🛃 ビデオ				
🎝 ミュージック				
🐛 Windows (C:)				
🧩 ポリューム (D:)				
SD SDXC (E:)				
🥌 Transcend (F:) 🛛 🗡	<			
ファイル名	(N): H01.txt	~	Text files (*.csv *.txt)	~
			開く(O) =	Fャンセル

Click on [OK]. Here, we assume a tsunami whose wave height is 7 m and half-wavelength is 600 sec.



The time steps of the tsunami wave height must be kept at the same value, including at the inflow location.

## **3** Setting the initial water surface profile

Calculation Condition		?	×
Groups Inflow/Outflow Initial Water Sur Time Others	Initial water surface Initial water surface slope of main channel	Constant slop	e V 0001

#### Click on [Initial Water Surface] from the [Group] list to make the following settings:

Initial water surface: constant slope

Initial water surface slope of main channel: 0.0001

Note: In order to give a nearly horizontal sea level in the downstream area, a very small value is given to [initial water surface slope of main channel].

The first water level data set for [Stage at downstream time series] (0 m in this sample) is regarded as the water level at the downstream end, and the initial water level is set to achieve nearly horizontal sea water level.

At locations where the ground elevation is set higher than the water surface elevation, the water-surface elevation will not be set.

# 4 Setting the time

R Calculation Condition		?	×	
Groups Inflow/Outflow Boundar Initial Water Surface Time Others	Output time interval (sec) Calculation time step (sec) Start time of output (sec) Start time of bomber (sec)		0	Output time interval (sec): 20 Calculation time step (sec): 0.1 Start time of output (sec): 0
Reset		OK Cance	əl	

Click on [Time] from the [Group] list to make the following settings:

## **5** Other settings

Finite differential method of advection terms: CIP method Real Calculation Condition  $\times$ ? Groups Maximum number of CIP method  $\sim$ Finite differential method of advection terms Inflow/Outflow .. iterations of water 10 🜲 Maximum number of iterations of water surface calculation Initial Water Sur... surface calculation: 10 Time Relaxation coefficient for water surface calculation 0.8 Others Minimum water depth 0.01 Relaxation coefficient for A for eddy viscosity coefficient (k/6u\*h x A + B) 1 water surface calculation: 0 B for eddy viscosity coefficient (k/6u\*h x A + B) 0.8 1 🜲 Number of threads for paralle computation (Only multi core PC) Inundation of buildings Disabled  $\sim$ Minimum water depth: Model parameter for flow resistance by buildings 0.383 0.01 How to calculate gamma gam\_x=gam\_y=1 -sqrt(1 -gam\_v) ~ A of eddy viscosity Reset OK Cancel coefficient: 1 B of eddy viscosity coefficient: 0

Click on [Others] from the [Group] list to make the following settings:

After making the settings above, click on [Save and Close] to close the window.

## 6 Inflow settings

Inflow river settings (or bank failure location settings) are made at the upstream end (red line). Note: This sample does not incorporate river discharge. However, Nays2D Flood requires at least one inflow location to be set on the upstream end.



Note: In this basin, an inflow to the mainstream occurs on the red line, as is shown by the blue arrow. Because this sample focuses on tsunami runup, a dummy inflow discharge datum (Discharge  $0 \text{ m}^3$ /s) is applied.

In the Object Browser, right-click [Boundary Condition Setting] and click [Add Inflow].



In the Object Browser, click [Boundary Condition Setting]-[New Inflow]. Surround the side of the position of the incoming river with polygons.



Double-click to confirm and the [Boundary condition] screen will be displayed.



On the [Boundary Condition] window, input "New Inflow 1" to the [Name] box, and select [Edit] for the [Discharge time series] box under [Setting].

The [Calculation Condition] wi	indow will be displayed.
--------------------------------	--------------------------

Click on [Import] on the [Calculation Condition] window.

The [Select text file] window will be displayed.

Time Discharge(m3/s)	Discharge tim	e series			?	×
0 200 400 600 800 1,00	Time	Discharge(m3/s)	Discharge(m3/s)			
Add Remove Time	A	dd Remove		0 200 400 Tin	600 800 ne	1,00

### Open [¥¥SampleData¥¥N2F], select [Q01.txt] and click on [Open].

Time series dummy discharge data (all discharges are zero) will be displayed.

Choose a text file							
→ <b>~</b> ↑ 📕	> PC	> ボリューム (D:) > SampleData > N2F_2	~	Ö	9	N2F_2の検索	
೬理▼ 新しいフォノ	ダー						
🦻 PC	^	名前 ^	更新日時			種類	サイズ
🧊 3D オブジェクト		H01.txt	2020/09/29	14:49		テキスト ドキュメント	
🖊 ダウンロード		Q01.txt	2020/09/29	14:49		テキスト ドキュメント	
🔜 デスクトップ							
🖹 ドキュメント							
📧 ピクチャ							
🧱 ビデオ							
🎝 ミュージック							
🐛 Windows (C:)							
🥧 ポリューム (D:)							
SD SDXC (E:)							
Transcend (F:)	v ·	C					
77	イル名(	N): Q01.txt		~	Text	: files (*.csv *.txt)	
						問((0) *	+>/+

### Click on [OK].



The time steps of the tsunami wave height must be kept at the same value, including at the inflow location.


#### In the menu bar, click [Grid]-[Attributes Mapping]-[Execute].

Inflow rivers are set on the sides.



The grid node indexes of the inflow location of the sample data is given below:

Inflow	Grid node indexes (i, j)	Discharge data	Note
Inflow 1	$(1, 17) \sim (1, 20)$	Q01.txt	



Inflow locations cannot be set at a grid node other than i=1, j=1 or j=nj.

When you set grid nodes other than those above as inflow locations, an error occurs and the simulation stops.

In such a case, select the grid node and right click to select [Delete].

# **7** Setting the roughness

In the Object Browser, select [Geographic Data] - [Roughness] and right click to select [Add] - [Polygon].



Click on several points to set several vertices such that the vertices enclose the grid area, and press the Enter key on your keyboard to complete the operation. Then, input a value of Manning's roughness coefficient for [Roughness condition] in the [Edit roughness condition value] window.



#### Setting Polygon

A polygon is set by enclosing the area by the line linking vertices made by clicking the location you want to set as a vertex. To finish, press the Enter key or double click.

Note: When setting Manning's roughness coefficient, first you make a polygon that encloses all grid nodes. Then, you make polygons that cover smaller regions with additional detail, if desired. In this way, you can set roughness coefficients, where necessary. Referring to the background image, repeat the procedure to add polygons as shown the figure below.

Name each polygon: In the Object Browser, select [Geographic Data] - [Roughness] and right click to open the [Edit Name] box. Input a simple name that expresses the roughness of the area specified by the polygon.

Name of polygon	Description	Roughness coefficient	Note
Forest	Forested mountains	0.030	
LowDensityArea	Low building density area	0.040	Residential area, etc.
HighDensityArea1	High building density area	0.080	Industrial area, etc.
HighDensityArea2	Ditto	0.080	
HighDensityArea3	Ditto	0.080	
Sea	Sea area	0.025	
River	River	0.025	

In the sample data, roughness coefficients are set as below:



Note: Manning's roughness coefficient is comprehensively set by considering simulation models, land use in the basin and past records. Refer to page 33 of *Flood Simulation Manual (Draft)* and page 89 of *The Collection of Hydraulic Formula*e (Japan Society of Civil Engineers (FY 1999).

# 8 Correcting elevation of sea area

In the Object Browser, select [Geographic Data] - [Roughness] - [sea]. Then, select [Copy] from right click.

Select [Elevation] on the [Select Geographic Data] window, and click on [OK]. Input [-3] on the [Edit Elevation value] window, and click on [OK].



Remove the check mark from the [Geographic Data] box in the Object Browser. In the Object Browser, select [Grid] - [Cell attributes] - [Roughness] and make a check mark in the [Roughness] box.

In the Object Browser, select [Grid] - [Grid shape] and make a check mark in the [Grid shape] box.



Note: Check whether the roughness coefficients are properly displayed on the grid.

# **3.** Making a simulation



On the menu bar, select [Simulation] - [Run].

The [Solver Console [Nays2D Flood] (running)] window will open to start the simulation.

R e:	(2.ip	ro - iRIC v4 4.0.0.6	5884 [Nays2D Fl	lood v5.0 64 bit	] - [Solver Cor	nsole [l	Nays2D Flood v5.0	64 bit] (rur	ining)]					×
Fil	e li	mport Calculation	on Condition	Simulation Ca	Iculation Resu	ult Vi	ew Option Help	,						_ 6 ×
	C	) 🗎 🖸 🗬	<b>S</b> ~ /	~ Q Ľ	<u>x</u> , <u>î∽</u> °   Y <sub>X</sub>	$Z_{Y}$	$z_X \ \leftarrow \ \rightarrow$	$\uparrow \downarrow$	$\odot$ $\odot$	• 🔳 🦯	** 2D 2	20 31	, [ <u>~</u> ,	Î <u>***</u> , ×
٠	1	Pre-processing V	/indow											23
<u>~</u> ?~	Ob	Nays2d_flo	od Solver '	Version 5.	0.0000 La:	st up	dated 2014/5	/14						
	~	Copyright ( Modified b	C) by Yasu v Tchiro K	yuki Shimi imura, Tosi	zu, Hokka: biki Twas	ido ( aki.	Jniv., Japan Satomi Kawam	ura. Ta	kuva Tnoue	Mic				
~		hihiro Ham	aki , Take	shi Takemu	ra		Deroomin Indiada		naya incac	,				
20			0	1	17		19							
			0	1	17		19							
			ŏ	ĩ	17		19							
			0	1	17		19							
		inflow(1=1 time	g input	h down										
		0.000	0.0000	0.0000	0.0000	out								
		20.000	0.0000	0.7240	0.0000	out								
		60.000	0.0000	2.1480	0.0000	out								
		80.000	0.0000	2.8240	0.0000	out								
		100.000	0.0000	3.5000	0.0000	out								
		140.000	0.0000	4.6600	0.0000	out								
	>													
	~													
														~
	<													>

# **4. Visualization of computational results**

### Open the 2D Post-processing window

1

On the menu bar, select [calculation results] - [Open New 2D Post-Processing Window].



The [Post-processing Window (2D)] will open.



# 2 Quantities that can be visualized

Names on the Object Browser	Description
• Contour	
Depth(Max)	The max. depth achieved by the end time of
	visualization (m)
Depth	Water depth at the time of visualization (m)
Elevation	Altitude of the grid for calculation (m)
WaterSurfaceElevation	Water level at the time of visualization (m)
Velocity (magnitude Max)	The max. flow velocity achieved by the end time
	of visualization (m/s)
Velocity (magnitude)	Flow velocity at the time of visualization (m/s)
• Vector	
Velocity	Vector of flow velocity (m/s) at the time of
	visualization
• Streamline	
Velocity	Displays the streamline
• Particles	
Velocity	Displays particles
• Cell attributes	
Obstacle cell (normal cell)	Displays normal cells
Obstacle cell (obstacle cell)	Displays obstacle cells
Bomber cell (normal cell)	Displays normal cells
Bomber cell (obstacle cell)	Displays bomber cells

# **3** Visualizing the water depth

In the Object Browser, select [Nays2D Flood Grids] - [iRICZone] - [Scalar] - [Depth] by making a check mark in each box.

A contour map of water depth will open.



In the Object Browser, select [Nays2D Flood Grids] - [iRICZone] - [Scalar]. Right click on [Depth] to select [Property].

The [Scalar Setting] window will open.



On the [Scalar Setting] window, make the following settings and click on [OK]:

Range       Presets:     [Please select if ∨ ] grore Color bar setting when importing       Relatorship between values and colors <ul> <li>Automatically adjust based on value range</li> <li>Setup Manually</li> </ul> Value Range           Automatic           Mar:         7           Colors         Add           Value         Color           1         7           2         52525           3         3505           4         17575           5         001	Color Bar Setting Visibility When selected Always Never Direction: Horizontal Vertical Title Title: Label Display Format: X52f Number of labels: Auto SC Font Setting: MS UI Gothic 14 pt Edit Label Display Format: X52f Number of labels: Auto SC Font Setting: MS UI Gothic 11 pt Edit Color Title: Label: Market Control I pt Edit Color	Value range: Remove ☑ from [Automatic] Max: 7 Min: 0.01 Remove ☑ from [Fill lower area] Colors : No change
☐ Fill lower area ☑ Fill upper area Switch to Discrete Mode	Size and Position       Position       O     O       Distance from right     10       Distance from bottom     100       Width:     150       Height:     200	Remove ☑ from Fill lower area Transparent: No change Color Bar Settiing: N change

The contour map is easier to see now.



# **4** Visualizing flow vector

In the Object Browser, select [Nays2D Flood Grids] - [iRICZone] - [Arrow] - [Velocity]. In the Object Browser, select [Nays2D Food Grids] - [iRICZone] - [Arrow]. Right click on [Arrow] to select [Property].

The [Contour Setting] window will open.



#### On the [Contour Setting] window, make the following settings and click on [OK]:

Velocity(ma-1)     Langth     Arrow Shape     Arrow Shape	Length Legend         Velibility         Web neelected ● Always ○ Never         Title         Forn Setting       MS UI Gothic 11 pt         Earlingth         Formst:       \$\$27         Forn Setting       MS UI Gothic 11 pt         Earlingth:       Earlingth         Background:       Intersperent         Background:       Interspect from right         Boltance from bottom       Io         With:       160 ©         With:       160 ©         With:       100 ©
---	--

#### Length

Remove 🗹 from [Auto]

Standard value: 8.00

Length on screen: 40

Minimum value to draw: 0.008

#### Sampling:

Sampling rate (Idirection): 2

Sampling rate (Jdirection): 2

#### **Resion**:

Do not change any settings.

On the menu bar, select [Animation] - [Reset].

On the menu bar, select [Animation] - [Start/Stop Animation].

Animated changes in inundation depth and flow vector will be displayed.



# 6 Visualizing time series data

On the menu bar, select [View] - [Pre-processor].

Zoom in on an arbitrary location. (Refer to [Mouse Hints])

In the Object Browser, select [Grid] - [Grid shape] and make a check mark in the [Grid shape] box.

Select one grid cell of arbitrary location by dragging it, and right click. Click on [Edit Coordinates].

The [Edit Grid Coordinates] will open. Find the grid node indices.



On the menu bar, select [Calculation Results] - [Open New Graph Window]. In the [Calculation Result] tab, select [WaterSurfaceElevation] and [Velocity (magnitude)] from [Two dimensional Data] to add [Selected Data]. Click on [OK].

A. 1. (71)				
Axis: Time Y				
Calculation Result Externa				
Point Data		Selected Data		
	Add N			
Two dimensional Data	Add 77			
Grid Location: Vertex 🗸	<< Remove			
Depth(Max)				
Depth				
WaterSurfaceElevation				
Velocity (magnitude Max)				
IBC Velocity(ms-1) (magnitude)				
veroerty(ms 1) (magnitude)				
		Setting		
		ОК	Cance	!
		OK	Cance	1
Data Source Setting		OK	Cance ?	:I ×
Data Source Setting		OK	Cance ?	×
Data Source Setting Axis: Time V		OK	Cance ?	×
Data Source Setting Axis: Time V Calculation Result Externa		OK Selected Data	Cance ?	×
Data Source Setting Axis: Time V Calculation Result Externa Point Data New Inflow1		OK Selected Data	Cance ?	×
Data Source Setting Axis: Time Calculation Result Externa Point Data New Inflow1		OK Selected Data WaterSurfaceEle Velocity(ms-1) (r	Cance ? vation magnitude	×
Data Source Setting Axis: Time ✓ Calculation Result Externa Point Data New Inflow1		OK Selected Data WaterSurfaceEle Velocity(ms-1) (n	Cance ? vation magnitude	×
Data Source Setting Axis: Time ✓ Calculation Result Externa Point Data New Inflow1		OK Selected Data WaterSurfaceElet Velocity(ms-1) (n	Cance ? vation magnitude	×
Data Source Setting Axis: Time ✓ Calculation Result Externa Point Data New Inflow1		OK Selected Data WaterSurfaceEler Velocity(ms-1) (n	Cance ? vation nagnitude	×
Data Source Setting Axis: Time ✓ Calculation Result Externa Point Data New Inflow1		OK Selected Data WaterSurfaceEler Velocity(ms-1) (n	Cance ? vation magnitude	)
Data Source Setting Axis: Time ✓ Calculation Result Externa Point Data New Inflow1		OK Selected Data WaterSurfaceElev Velocity(ms-1) (n	Cance ? vation magnitude	×
Data Source Setting Axis: Time ✓ Calculation Result Externa Point Data New Inflow1	Add >>	OK Selected Data WaterSurfaceEle Velocity(ms-1) (n	Cance ? vation magnitude	×
Data Source Setting Axis: Time  Calculation Result Externa Calculation Result Externa New Inflow1 Two dimensional Data	Add >>	OK Selected Data WaterSurfaceEle Velocity(ms-1) (n	Cance ? vation magnitude	))
Data Source Setting Axis: Time ✓ Calculation Result Externa Point Data New Inflow1 Five dimensional Data Arid Location: Vertex ✓	Add >> << Remove	OK Selected Data WaterSurfaceEler Velocity(ms-1) (n	Cance ? vation magnitude	-1 ×
Data Source Setting Axis: Time ✓ Calculation Result Externa Point Data New Inflow1 Five dimensional Data Grid Location: Vertex ✓ Depth(Max) Depth	Add >> << Remove	OK Selected Data WaterSurfaceEle Velocity(ms-1) (n	Cance ? vation magnitude	)
Data Source Setting Axis: Time ✓ Calculation Result Externa Point Data New Inflow1	Add >> ≪ Remove	OK Selected Data WaterSurfaceEle Velocity(ms-1) (n	Cance ? vation magnitude	)
Data Source Setting Axis: Time  Calculation Result Externa Calculation Result Externa Point Data New Inflow1 Five dimensional Data Grid Location: Vertex  Depth(Max) Depth Elevation Velocity (magnitude Max)	Add >> << Remove	OK Selected Data WaterSurfaceEle Velocity(ms-1) (n	Cance ? vation magnitude	)
Data Source Setting Axis: Time  Calculation Result Externa Point Data New Inflow1  Two dimensional Data Grid Location: Vertex  Depth(Max) Depth Elevation Velocity (magnitude Max) IBC	Add >> << Remove	OK Selected Data WaterSurfaceEle Velocity(ms-1) (n	Cance ? vation magnitude	
Data Source Setting Axis: Time  Calculation Result Externa Point Data New Inflow1  Fwo dimensional Data Grid Location: Vertex  Depth(Max) Depth Elevation Velocity (magnitude Max) IBC	Add >> << Remove	OK Selected Data WaterSurfaceEle Velocity(ms-1) (n	Cance ? vation magnitude	
Data Source Setting Axis: Time  Calculation Result Externa Coint Data New Inflow1  Five dimensional Data Grid Location: Vertex  Depth(Max) Depth Elevation Velocity (magnitude Max) IBC	Add >> <<< Remove	OK Selected Data WaterSurfaceElet Velocity(ms-1) (n	Cance ? vation magnitude	
Data Source Setting Axis: Time  Calculation Result Externa Point Data New Inflow1  Fwo dimensional Data Grid Location: Vertex  Depth(Max) Depth Elevation Velocity (magnitude Max) IBC	Add >> Remove</td <td>OK Selected Data WaterSurfaceEler Velocity(ms-1) (n</td> <td>Cance ? vation magnitude</td> <td></td>	OK Selected Data WaterSurfaceEler Velocity(ms-1) (n	Cance ? vation magnitude	

The grid node indices from an arbitrary location that were identified before are input to the [I] and [J] box boxes of [Controller].

Click on [Draw Setting] to set the [Draw Setting] window as below and click on [OK]. Click on [OK].

Time series graph of the arbitrary location will be displayed.



### Click on [CSV Export]. Set the [CSV Export] window as below, and click on [OK].

### Click on [OK].

The time series data of an arbitrary location will be exported.



CSV Export Setting ? X
Folder & Prefix
Folder: )flood事例集¥for_version4.0
Prefix: ExportData
Region
Current Only Full Region
I Min:
I Max:
J Min:
J Max:
Time Current Only All Timesteps
Start: 1800
End: 1800 Skip rate : 1 -
OK Cancel
CSV Export ? X
Saving csv files
13%
Cancel

Folder: Any

(The folder can be the same as that for storing the sample data)

Prefix: Do not change any settings.

Region: Do not change any settings.

Time: All Time steps

# **5. Important information**

### Tsunami runup

In this tutorial, tsunami waves are generated by inputting only the water level at the downstream end. For an accurate simulation, a wide-area analysis of tsunami wave propagation from the wave origin should be made to input boundary conditions of water-surface elevation AND flow velocity. The objective of the example introduced by this tutorial is to assess the inundation area by a simple method. In future, we will improve this simulation software so that the results of tsunami wave propagation analysis (water surface elevation and flow velocity) can be input as data to the boundary condition at the downstream end of the simulation.

For details of updates, refer to http://i-ric.org/ja/downloads.

# Chapter 4 Examples of Rainfall Induced Flooding in Actual River

# Objectives

The objectives are to use Shuttle Radar Topography Mission (SRTM) data, to simulate and visualize the simulated flow regime, such as water surface elevation and flow velocity, at a river when rainfall induced flooding occurs with Nays2D Flood.

# Outline

### 1. Creating the calculation grid

Using elevation data of an actual river basin, create calculation grids: 101 division points in the transverse direction, and 131 division points in the longitudinal direction.

### 2. Setting the calculation conditions

Set a value for Elevation, Rainfall and Inflow Discharge. Set various other conditions necessary for simulation.

### 3. Making a simulation

### 4. Visualizing the calculation results

Here, we introduce how to display a water depth contour map and a flow velocity vector map.

# **1. Creating the calculation grid**



#### In the Object Browser, click [Option]-[Preferences]



In [Preferences] scroll to [Background Images (Internet)]

Select [GSI (English) (Japan only)] and [GSI (Ortho images) (Japan Only)]

In the Object Browser, right-click [Geographic Data]-[Elevation].Click [Import elevation from web].

Jntitled - IRIC v4 4.0.0.6884 [Nays2D Flood v5.0 64 bit] - [Pre-processing Window]	- 0
le Import Geographic Data Grid Measured Values Calculation Condition Simulation Calculation Result View Option Help	-
(J ➡ ○ ♠ ○ □ □ Q ↓ ★ Y Z Z ← → ↑ ↓ Q Q ► ■ / = 20 20 30	1 · · · · · · · · · · · · · · · · · · ·
1 1	
Object Browser ×	
V 🖉 🛅 Geographic Data 🔥	
C Elevation	
Obstacle Import	
🖂 🎦 Xrain 🗧 Import Elevation from web	
Bomber Add	
🖂 📄 Roughness 🖙 Export All Polygons	
🖉 🚞 Areal fractic	
P eference li Goor Setting.	
Grid Creating G in Delete Selected	
Boundary Cond in Delete All	
Cind (No Data)	
Beolingary Condit	
Wessing values	
V December 1 and 1 and 1 and 1	
Concernation margers	
Goode Map (@	Elevation
Google Map (/	
Google Map (#c	0.
Open Street Map	0.
🗌 📄 国土地理院 (標	0
□ □ 国土地理院 (淡	0
□ □ 国土地理院 (Eng	0.
	0.
	0
Axes	Ŭ8.
Ustance Measures	
Measure1 V	
X	: -2.151453 Y: 1.245472

[Select Region] screen is displayed. Drag the target part and click [Next].

[Select Coordinate System] screen is displayed.

Search with JGD and select [EPSG:2454:JGD2000/Japan Plane Rectangular CS XII].

R Select Coordinate System	?	×
Search: japan		
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:2451: JGD2000 / Japan Plane Rectangular	CS IX	
EPSG:2452: JGD2000 / Japan Plane Rectangular	CS X	
EPSG:2453: JGD2000 / Japan Plane Rectangular	CS XI	
EPSG:2454: JGD2000 / Japan Plane Rectangular	CS XII	
EPSG:2455: JGD2000 / Japan Plane Rectangular	CS XIII	$\overline{}$
<	>	
Hint about Japanese coordinate systems (EPSG:24	143 - 246	1)
Hint about UTM coordinate systems (EPSG:32601	- 32760 (	etc.)
OK	Cancel	

# Select [GSI (English)(Japan Only)] in Background Images [Zoom In] towards 'Japan'



### [Zoom In] towards 'Japan' so that you can spot 'Sapporo'



# [Zoom In] towards 'Sapporo'

Dianu R. Config 55 XXX Background Image: GSI (English) (Jacon only)

Zoom In Zoom Out



### Try to Spot 'Chitose' and [Zoom In] towards 'Chitose'

Next Cancel



#### [Zoom In] towards 'Chitose' so that you can spot 'Lake Utonai'

### Drag the target part and click [Next].



[Zoom Level Setting] screen will be displayed. Specify the zoom level and select the source

🔎 Zoom Level Setting	?	$\times$
Specify the zoom level of data you want to i Zoom level: 11 🖨	mport.	
Resolution: 56.1319 m Data size: 1 MB (393216 points)		
Source: USGS elevation tiles (SRTN	1)	•
OK	Can	œl

#### Zoom level: 11 Source: USGS (SRTM)

Note: Since the resolution of the SRTM data is 90 m mesh, even if the zoom level is set to 11 or more here, the data does not change because the maximum resolution has been reached. Therefore, the zoom level is set to 11.

Reading is successful if the shape of the watershed to be calculated is displayed on [Preprocessing Window] screen.



When one of the items in the background image of the object browser is checked, the background image is displayed.



When creating grids for calculation, importing background images such as maps and aerial photos makes it possible to create grids that incorporate riverbanks and land use. Obstacle cells and roughness cells mentioned below can be set in reference to the background image.

Since the coordinate system is selected, it is set automatically



On the menu bar, select [Grid] - [Select algorithm to create grid]. The [Select Grid Creating Algorithm] window will be displayed.

Select [Create grid from polygonal line and width] from the list under the [Select Grid Creating Algorithm] window, and click on [OK].

Nays2D Flood generates a grid from polygonal lines and widths.

C Select Grid Creating Algorithm		?	×
Algorithm:	Description:		
Create grid from polygonal line and widt Create grid from cross-section data Create grid by dividing rectangular region Create grid by dividing rectangular region Create grid by dividing rectangular region Create grid shape solving Poisson equation General purpose grid generation tool u-shape grid generator for Nays3dv 2d arc grid generator for Nays3dv 2d arc grid generator 2d arc grid generator (Compound Channe Grid Generator for Nays2Dv Grid Generator for Nays3Dv Multifunction Grid Genarator Simple Straight and Meandering Channel U-shape channel generator	First, please define polygonal line, by clicking. The polygonal line is used as line of the grid. Then, you define the division number of grid in I direction a direction.	mouse- s the cer width, and J	nter
	ОК	Cance	el

### **3** Creating a grid

Click on several points through which the grid centerline passes and press the Enter key on your keyboard to draw a centerline.



#### In the [Grid Creation] window, make the following settings and click on [OK].



[nj] (Number of divisions in the longitudinal direction): 120
[ni] (Number of divisions in the transverse direction): 100
[W] (Grid width): 10000 m
Note: In this example, grid cell intervals di, dj are set at around 70 and 100 m
respectively.

#### Click on [Yes] in the [Confirmation] window.



#### A grid will be created.



# **2. Setting the calculation conditions**

# 1 Open [Calculation Condition]

On the menu bar, select [Calculation Condition] - [Setting].

The [Calculation Condition] window will open.



# **2** Setting the inflow boundary conditions

Click on [Inflow Boundary Condition] from the [Group] list to make the following settings: Click on [Stage at downstream time series] to edit.

The [Calculation Condition] window will open.

Groups Inflow/Outflow Initial Water Sur Time Others	n Time unit of discharge/water surface file Boundary Conditions for j=1 Boundary Conditions for j=nj Water surface at downstream Constant value (m) Stage at downstream time series Rainfall Rainfall time series(mm/h)	<pre>? × Hour  Hour  Outflow  Free outflow  O Edit with Edit</pre>	[Time unit of discharge/water surface file]: Hour [Boundary Conditions for j=1]: Inflow [Boundary Conditions for j=nj]: Outflow [Water surface at downstream]: Free Outflow Rainfall: with Rainfall time Series: Import Chitose_Rainfall.csv from test file
Reset	0	K Cancel	

### Click on [Import] on the [Calculation condition] window.

The [Select text file] window will be displayed.



Select [¥¥SampleData¥¥N2F\_3] - [Chitose\_Rainfall.csv] and click on [Open].

Time series of rainfall data is displayed.

💦 Choose a text file							×	<
← → ~ ↑ <mark> </mark> >	PC >	ポリューム (D:) > SampleData > N2F_3	~	Ü	0	N2F_3の検索		
整理 ▼ 新しいフォル	ダー					₽== <b>▼</b>	•	
🧢 PC	^	名前 ^	更新日時			種類	サイズ	
🧊 3D オブジェクト		BibiRiver_inflow_dammy.csv	2020/09/12	22:20		Microsoft Excel CS		1
🖊 ダウンロード		Chitose_Rainfall.csv	2020/09/12	22:17		Microsoft Excel CS		1
📃 デスクトップ								
🏥 ドキュメント								
📰 ピクチャ								
🔡 ビデオ								
🎝 ミュージック								
💺 Windows (C:)								
🥿 ボリューム (D:)								
SDXC (E:)								
Transcend (F:)	~ <							>
77	イル名(N	): Chitose_Rainfall.csv		~	Text	files (*.csv *.txt)	$\sim$	
						開く(O) キャ	ンセル	

#### Click on [OK].

#### Here, we assume a tsunami whose wave height is 7 m and half-wavelength is 600 sec.



The time steps of the tsunami wave height must be kept at the same value, including at the inflow location.

# **3 Setting the initial water surface profile**

Groups       Inflow/Outflow         Initial Water Sur       Initial water surface       Constant slope          Initial Water Sur       Initial water surface slope of main channel       0.0001	,	
Time Others Reset OK Canos		Initial water surface: constant slope Initial water surface slope of main channel: 0.0001

Click on [Initial Water Surface] from the [Group] list to make the following settings:

# 4 Setting the time

### Click on [Time] from the [Group] list to make the following settings:

				_
R Calculation Condition		?	×	
Groups Inflow/Outflow Boundar Initial Water Surface Time Others	Output time interval (sec) Calculation time step (sec) Start time of output (sec) Start time of bomber (sec)		360 1 0	Output time interval (sec): 360 Calculation time step (sec): 1 Start time of output (sec): 0 Start time of bomber (sec): 0
Reset		ОК С	ancel	

# **5** Other settings

Click on [Others] from the [Group] list to make the following settings:

R Calculation Conditio	n	? X	Finite differential method of advection terms: CIP method
Groups Inflow/Outflow Initial Water Sur Time Others Reset	Finite differential method of advection terms Maximum number of iterations of water surface calculation Relaxation coefficient for water surface calculation Minimum water depth A for eddy viscosity coefficient (k/6u⊀h x A + B) B for eddy viscosity coefficient (k/6u⊀h x A + B) Number of threads for paralle computation (Only multi core PC) Inundation of buildings Model parameter for flow resistance by buildings How to calculate gamma	CIP method ~ 10 08 001 1 0 1 0 1 0 0 0 383 m_x=gam_y=1-sqrt(1-gam_v) ~	Maximum number of iterations of water surface calculation: 10 Relaxation coefficient for water surface calculation: 0.8 Minimum water depth: 0.01 A of eddy viscosity coefficient: 1
			B of eddy viscosity coefficient: 0

After making the settings above, click on [Save and Close] to close the window.
## 6 Inflow settings

Nays2D Flood requires at least one inflow location to be set on the upstream end.



In the Object Browser, right-click [Boundary Condition Setting] and click [Add Inflow].

In the Object Browser, click [Boundary Condition Setting]-[Add Inflow].Surround the side of the position of the incoming discharge with polygons.



Zoom the Grid to make it easier to add Inflow points.

Mouse Hint: Ctrl+Mouse wheel = Zoom IN/Zoom OUT



#### Double-click to confirm and the [Boundary condition] screen will be displayed.

On the [Boundary Condition] window, input "Inflow 1" to the [Name] box, and select [Edit] for the [Discharge time series] box under [Setting].



The [Calculation Condition] window will be displayed.

Open [¥¥SampleData¥¥N2F\_3], select [BibiRIver\_Inflow\_dummy.csv] and click on [Open].

Time series dummy discharge data (all discharges are zero) will be displayed.

Choose a text file				×
- → × ↑ 📕 > P	C 〉 ボリューム (D:) 〉 SampleData 〉 N2F_3	ע י	○ N2F_3の検索	
整理▼ 新しいフォルダー				•
	~	更新日時	種類	サイズ
🧊 3D オブジェクト	BibiRiver_inflow_dammy.csv	2020/09/12 22:20	Microsoft Excel CS	1
🖊 ダウンロード	Chitose_Rainfall.csv	2020/09/12 22:17	Microsoft Excel CS	1
🔜 デスクトップ				
🗎 ドキュメント				
📰 ピクチャ				
🛃 ビデオ				
🎝 ミュージック				
💺 Windows (C:)				
🧅 ボリューム (D:)				
SDXC (E:)				
🥌 Transcend (F:) 🗸 🗸	<			>
ファイル	名(N): BibiRiver_inflow_dammy.csv	~ Te	ext files (*.csv *.txt)	$\sim$

### Click on [OK].

Discharge time	series		r x	🔎 Boundary Condition 🧧 🛛 🗙
Time Time 2 3 4 5 6 5	Discharge(m3/s)           0	∧ 0.6 0.4 0.4 0.4 0.4 0.4 0.4 0.4 0.4 0.4 0.4		Type: Inflow Name: New Inflow Setting Discharge time series Edit Slope value at inflow 0.001
7 6 8 7 9 8 10 9 11 10	0 0 0 0 0 Export Clear	-0.6 -0.0 -0.6	4 6 8 10 12 Time OK Cancel	Color: Transparent 50 Line Width: 7 Show name



#### In the menu bar, click [Grid]-[Attributes Mapping]-[Execute].

#### In Attribute Mapping bar -click [Check All]- [OK]

Attribute Mapping ? X	
Geographic Data          Geographic Data         Elevation         Obstacle         Xrain         Bomber         Roughness condition         Areal fraction that buildings occupy(max=0.95)	
Boundary Condition Setting           Image: Setting setti	

# 7 Setting the roughness

In the Object Browser, select [Geographic Data] - [Roughness] and right click to select [Add] - [Polygon].



Click on several points to set several vertices such that the vertices enclose the grid area, and press the Enter key on your keyboard to complete the operation. Then, input a value of Manning's roughness coefficient for [Roughness condition] in the [Edit roughness condition value] window.



#### Setting Polygon

A polygon is set by enclosing the area by the line linking vertices made by clicking the location you want to set as a vertex. To finish, press the Enter key or double click.

Note: When setting Manning's roughness coefficient, first you make a polygon that encloses all grid nodes. In this example, you want to set the same roughness condition for the entire grid.

# **3.** Making a simulation

R ex3.ipro - iRIC v4 4.0.0.6884 [Nays2D Flood v5.0 64 bit] - [Pre-processing Window]		×
🌽 File Import Geographic Data Grid Measured Values Calculation Condition Simulation Calculation Reserving Option Help		- 8 ×
[= () ] ] @ ] @ ] [ ] [ ] [ ] [ ] [ ] [ ] [ ]	1	>>
Object Browser × V Commandation Data		

The [Solver Console [Nays2D Flood] (running)] window will open to start the simulation.

ex3.ipro - iRIC v4 4.0	.0.6884 [Navs2D	Flood v5.0 64	bit] - [Solver (	Console (Navs	2D Flood v	5.0 64 bitl (r	unnina)1					- 0	×
File Import Calcula	ation Condition	Simulation	Calculation R	esult View	Option H	lelp	5.7						- & ×
- 🌙 💾 💽 🕻	<b>C S </b>	$\sim 0$	<sup>↑</sup> <sup>×</sup> , <sup>↑</sup> <b><sup>90</sup> </b>	x z <sub>y</sub> z <sub>x</sub>	← →	· ↑ ↓	$\ominus$ $\ominus$		/ 🛄 2D	20 3D	, î, îQ,   <b>(</b>	56	
Nays2d_flood Copyright(C) Modified by	d Solver Ve ) by Yasuyu Ichiro Kim ki . Takesh	rsion 5.0 ki Shimiz ura, Tosh i Takemur	.0000 Last u, Hokkaid iki Iwasa} a	updated lo Univ., ti, Satomi	2014/5/ Japan Kawamu	14 ra, Taku	ya Inoue	, Mic					
0	KI / IAKOON	1	34	36									
0		1	34	36									
0		1	34	36									
0		1	34	36									
inflow(i=1)	New Inflow1	•	54	50									
time	q input	h down											
0.000	0.0000	0.0000	0.0000 0	ut									
360.000	0.0000	0.0000	0.8000 c	out									
720.000	0.0000	0.0000	1.6000 c	ut									
1440 000	0.0000	0.0000	3 2000 6	ut.									
1800.000	0.0000	0.0000	4.0000 0	ut									
											(·	V	

# 4. Visualization of computational results

Open the 2D Post-processing window

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27360.000       0.0000       38.0000 out         27360.000       0.0000       38.0000 out         27380.000       0.0000       41.2000 out         28080.000       0.0000       44.4000 out         28440.000       0.0000       44.4000 out         28400.000       0.0000       44.4000 out         28400.000       0.0000       44.4000 out         29160.000       0.0000       44.000 out         29160.000       0.0000       44.000 out         29520.000       0.0000       44.000 out         29800.000       0.0000       34.000 out         29800.000       0.0000       42.000 out         3060.001       0.0000       0.0000 out         3060.000       0.0000       14.000 out         3040.000       0.0000       6.000 out         31260.000       0.0000       6.000 out         31240.000       0.0000       5.200 out         31240.000       0.0000       5.200 out         31240.000       0.0000       2.6000 out         31240.000       0.0000       2.6000 out         31240.000       0.0000       2.6000 out         31240.000       0.0000       2.600 out			$\sim$ O	<sup>™</sup> x, <sup>™</sup> , <sup>™</sup> X	$Z_{Y} Z_{X} \leftarrow -$	$\rightarrow \uparrow \downarrow$	$\oplus \odot$	/ 📰 🗾	20 3D L.	t., 19, C	5 6	
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2772.000 0.0000 0.0000 41.2000 out 28480.000 0.0000 0.0000 44.4000 out 28480.000 0.0000 0.0000 42.0000 out 29160.000 0.0000 0.0000 42.0000 out 29280.000 0.0000 0.0000 34.000 out 39240.000 0.0000 0.0000 34.000 out 39240.000 0.0000 0.0000 22.0000 out 39240.000 0.0000 0.0000 14.000 out 39240.000 0.0000 0.0000 5.2000 out 39240.000 0.0000 0.0000 1.6000 out 39240.000 0.0000 0.0000 1.6000 out 39260.000 0.0000 0.0000 1.8000 out 39280.000 0.0000 0.0000 1.8000 out	27360.000	0.0000	0.0000	39.6000 out								
28080.000         0.0000         42.6000         out           28440.000         0.0000         44.4000         out           2850.000         0.0000         44.000         out           2952.000         0.0000         0.0000         34.000         out           2952.000         0.0000         0.0000         34.000         out           2952.000         0.0000         0.0000         34.000         out           30240.000         0.0000         30.000         out           30240.000         0.0000         0.0000         14.000           3180.000         0.0000         14.000         out           31420.000         0.0000         14.000         out           31420.000         0.0000         0.0000         14.000           3140.000         0.0000         6.000         out           3140.000         0.0000         4.000         out           3140.000         0.0000         4.000         out           3140.000         0.0000         4.000         out           3140.000         0.0000         3.200         out           3140.000         0.0000         3.200         out           3140.	27720.000	0.0000	0.0000	41.2000 out								
28440.000       0.0000       44.4000       out         28400.000       0.0000       42.0000       out         29500.000       0.0000       42.0000       out         29500.000       0.0000       42.0000       out         29500.000       0.0000       34.0000       out         29500.000       0.0000       34.0000       out         29500.000       0.0000       34.0000       out         29500.000       0.0000       26.0000       out         3060.000       0.0000       26.0000       out         39560.000       0.0000       0.0000       out         3160.000       0.0000       0.0000       out         3240.000       0.0000       0.0000       out         3240.000       0.0000       0.0000       out         3340.000       0.0000       5.2000       out         33480.000       0.0000       3.6000       out         3520.000       0.0000       3.6000       out         3540.000       0.0000       2.8000       out         3540.000       0.0000       1.8000       out         3540.000       0.0000       1.8000       out	28080.000	0.0000	0.0000	42.8000 out								
28800.000       0.0000       46.0000       out         29500.000       0.0000       32.0000       out         29520.000       0.0000       30.0000       out         30240.000       0.0000       30.0000       out         30240.000       0.0000       30.0000       out         30260.000       0.0000       30.0000       out         30260.000       0.0000       22.0000       out         30260.000       0.0000       14.0000       out         31220.000       0.0000       0.0000       14.0000         31240.000       0.0000       0.0000       0.0000         31240.000       0.0000       0.0000       cut         32440.000       0.0000       6.0000       out         31220.000       0.0000       6.0000       out         31240.000       0.0000       6.0000       out         3140.000       0.0000       6.0000       out         3140.000       0.0000       4.0000       out         3140.000       0.0000       3.2000       out         3540.000       0.0000       3.2000       out         3540.000       0.0000       3.2000       out	28440.000	0.0000	0.0000	44.4000 out								
2916.000       0.0000       42.0000       out         2950.000       0.0000       34.0000       out         2980.000       0.0000       34.0000       out         3060.000       0.0000       34.0000       out         3060.000       0.0000       26.0000       out         3040.000       0.0000       10.0000       out         3040.000       0.0000       10.0000       out         3120.000       0.0000       10.0000       out         3120.000       0.0000       0.0000       out         3240.000       0.0000       0.0000       cut         3240.000       0.0000       0.0000       cut         3340.000       0.0000       5.2000       out         3340.000       0.0000       5.2000       out         3340.000       0.0000       4.4000       out         3420.000       0.0000       3.6000       out         3540.000       0.0000       2.0000       out         3540.000       0.0000       2.0000       out         3540.000       0.0000       2.0000       out         3540.000       0.0000       2.0000       out	28800.000	0.0000	0.0000	46.0000 out								
2952.000       0.0000       30.000       ut         30240.000       0.0000       30.000       ut         30240.000       0.0000       30.000       ut         3050.000       0.0000       22.000       ut         3040.000       0.0000       22.000       ut         3050.000       0.0000       22.000       ut         3050.000       0.0000       14.000       ut         3120.000       0.0000       14.000       ut         3240.000       0.0000       0.6000       ut         3120.000       0.0000       0.6000       ut         3140.000       0.0000       5.200       ut         3140.000       0.0000       5.200       ut         3140.000       0.0000       4.000       ut         3140.000       0.0000       4.000       ut         3140.000       0.0000       3.200       ut         3140.000       0.0000       3.200       ut         3140.000       0.0000       3.200       ut         3140.000       0.0000       3.200       ut         31540.000       0.0000       1.800       ut         31540.000       0	29160.000	0.0000	0.0000	42.0000 out								
99880.000       0.0000       34.0000       out         30640.000       0.0000       0.0000       26.0000       out         30600.000       0.0000       18.0000       out         31220.000       0.0000       18.0000       out         31240.000       0.0000       18.0000       out         32400.000       0.0000       10.0000       out         32400.000       0.0000       10.0000       out         32400.000       0.0000       5.6000       out         33480.000       0.0000       5.6000       out         33480.000       0.0000       4.0000       out         34560.000       0.0000       3.2000       out         34560.000       0.0000       3.2000       out         3540.000       0.0000       1.8000       out         3540.000       0.0000       1.8000 <t< td=""><td>29520.000</td><td>0.0000</td><td>0.0000</td><td>38.0000 out</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></t<>	29520.000	0.0000	0.0000	38.0000 out								
30240.000       0.0000       30.0000       out         30560.000       0.0000       22.0000       out         30560.000       0.0000       22.0000       out         31520.000       0.0000       14.0000       out         31580.000       0.0000       14.0000       out         3120.000       0.0000       14.0000       out         32400.000       0.0000       6.0000       out         32400.000       0.0000       6.0000       out         32400.000       0.0000       6.0000       out         32400.000       0.0000       6.0000       out         33400.000       0.0000       6.0000       out         34200.000       0.0000       3.2000       out         35400.000       0.0000       2.4000       out         35400.000       0.00000       1.8000       out     <	29880.000	0.0000	0.0000	34.0000 out								
00000.000       0.0000       26.0000 out         00000.000       0.0000       18.0000 out         1122.000       0.0000       18.0000 out         22040.000       0.0000       10.0000 out         32400.000       0.0000       10.0000 out         32400.000       0.0000       10.0000 out         32400.000       0.0000       5.6000 out         3120.000       0.0000       5.6000 out         33400.000       0.0000       4.6000 out         33400.000       0.0000       4.6000 out         34500.000       0.0000       4.6000 out         34500.000       0.0000       3.2000 out         35280.000       0.0000       3.2000 out         3540.000       0.0000       1.6000 out         35280.000       0.0000       3.2000 out         3540.000       0.0000       1.8000 out         3540.000       0.0000       1.8000 out         35280.000       0.0000       1.8000 out         37000.000       0.0000       1.8000 out         37440.000       0.0000       1.6000 out         38280.000       0.0000       0.6000 out         38280.000       0.0000       0.6000 out      >	30240.000	0.0000	0.0000	30.0000 out								
30966.000       0.0000       22.0000       out         31820.000       0.0000       14.0000       out         31840.000       0.0000       14.0000       out         32400.000       0.0000       14.0000       out         32400.000       0.0000       6.0000       out         32400.000       0.0000       6.0000       out         32400.000       0.0000       5.0000       out         33400.000       0.0000       5.2000       out         33400.000       0.0000       4.4000       out         34200.000       0.0000       4.4000       out         34200.000       0.0000       3.6000       out         34200.000       0.0000       3.6000       out         34200.000       0.0000       3.6000       out         34200.000       0.0000       3.6000       out         34520.000       0.0000       2.4000       out         35400.000       0.0000       1.6000       out         35400.000       0.0000       1.6000       out         35400.000       0.0000       1.6000       out         37000.000       0.00000       1.6000       out </td <td>30600.000</td> <td>0.0000</td> <td>0.0000</td> <td>26.0000 out</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td>	30600.000	0.0000	0.0000	26.0000 out								
31320.000       0.0000       16.0000 out         31600.000       0.0000       10.0000 out         32040.000       0.0000       10.0000 out         32100.000       0.0000       5.6000 out         33120.000       0.0000       5.6000 out         33400.000       0.0000       5.6000 out         33400.000       0.0000       4.6000 out         33400.000       0.0000       4.6000 out         34200.000       0.0000       4.6000 out         34200.000       0.0000       4.6000 out         34200.000       0.0000       4.6000 out         3420.000       0.0000       3.2000 out         3420.000       0.0000       3.2000 out         35280.000       0.0000       2.4000 out         3540.000       0.0000       1.8000 out         37440.000       0.0000       1.6000 out         38280.000       0.0000       0.6000 out         38280.000       0.0000       0.6000 out	30960.000	0.0000	0.0000	22.0000 out								
31680.000       0.0000       14.0000       out         32400.000       0.0000       0.0000       6.0000       out         32400.000       0.0000       0.0000       6.0000       out         32400.000       0.0000       6.0000       out         33120.000       0.0000       5.2000       out         33400.000       0.0000       6.0000       out         33400.000       0.0000       6.4000       out         33400.000       0.0000       4.4000       out         34200.000       0.0000       4.4000       out         34200.000       0.0000       3.6000       out         34500.000       0.0000       3.6000       out         34500.000       0.0000       3.6000       out         34500.000       0.0000       2.4000       out         35400.000       0.0000       1.6000       out         37000.000       0.0000       1.6000       out         37440.000       0.0000       1.6000       out         37440.000       0.0000       0.6000       out         3820.000       0.0000       0.6000       out         39240.000       0.0000 <t< td=""><td>31320.000</td><td>0.0000</td><td>0.0000</td><td>18.0000 out</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></t<>	31320.000	0.0000	0.0000	18.0000 out								
3240.000       0.0000       10.0000       out         3240.000       0.0000       5.6000       out         3276.000       0.0000       5.6000       out         3340.000       0.0000       5.6000       out         3340.000       0.0000       4.8000       out         3340.000       0.0000       4.4000       out         3450.000       0.0000       4.0000       out         3450.000       0.0000       4.0000       out         3450.000       0.0000       3.2000       out         3450.000       0.0000       3.2000       out         35280.000       0.0000       3.2000       out         3540.000       0.0000       2.4000       out         3540.000       0.0000       1.8000       out         3600.000       0.0000       1.8000       out         37440.000       0.0000       1.6000       out         37440.000       0.0000       0.6000       out         38280.000       0.0000       0.6000       out         38280.000       0.0000       0.6000       out         38280.000       0.0000       0.6000       out	31680.000	0.0000	0.0000	14.0000 out								
3240.000       0.0000       6.0000       etc.         332760.000       0.0000       5.2000       etc.         33280.000       0.0000       5.2000       etc.         3340.000       0.0000       5.2000       etc.         3340.000       0.0000       4.6000       etc.         3340.000       0.0000       4.6000       etc.         3420.000       0.0000       4.6000       etc.         3420.000       0.0000       4.6000       etc.         3450.000       0.0000       3.6000       etc.         34520.000       0.0000       3.6000       etc.         35280.000       0.0000       2.8000       etc.         35440.000       0.0000       1.8000       etc.         35440.000       0.0000       1.8000       etc.         37800.000       0.0000       1.8000       etc.         37440.000       0.0000       1.2000       etc.         3880.000       0.0000       0.6000       etc.         3880.000       0.0000       0.6000       etc.         37400.000       0.0000       0.6000       etc.         3880.000       0.0000       0.6000       etc.	32040.000	0.0000	0.0000	10.0000 out								
32760.000       0.0000       5.6000 out         33480.000       0.0000       5.2000 out         33480.000       0.0000       4.8000 out         3420.000       0.0000       4.8000 out         3420.000       0.0000       4.0000 out         3420.000       0.0000       4.0000 out         3420.000       0.0000       4.0000 out         3450.000       0.0000       3.2000 out         35280.000       0.0000       2.8000 out         3540.000       0.0000       2.4000 out         3540.000       0.0000       2.4000 out         3600.000       0.0000       1.8000 out         3640.000       0.0000       1.8000 out         3740.000       0.0000       1.4000 out         37440.000       0.0000       1.6000 out         3820.000       0.0000       0.6000 out         3940.000       0.0000       0.6000 out         3940.000       0.0000       0.6000 out         3940.000	32400.000	0.0000	0.0000	6.0000 out								
3312.000       0.0000       5.2000       cut         3340.000       0.0000       4.4000       cut         3340.000       0.0000       4.4000       cut         3440.000       0.0000       4.4000       cut         3450.000       0.0000       4.4000       cut         3450.000       0.0000       3.600       cut         3520.000       0.0000       2.8000       cut         35240.000       0.0000       2.4000       cut         35240.000       0.0000       2.4000       cut         35240.000       0.0000       2.4000       cut         35240.000       0.0000       1.6000       cut         3520.000       0.0000       1.6000       cut         3630.000       0.0000       1.2000       cut         3740.000       0.0000       1.2000       cut         3780.000       0.0000       0.8000       cut         3820.000       0.0000       0.8000       cut         3820.000       0.0000       0.8000       cut         3740.000       0.0000       0.8000       cut         3820.000       0.0000       0.8000       cut <t< td=""><td>32760.000</td><td>0.0000</td><td>0.0000</td><td>5.6000 out</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></t<>	32760.000	0.0000	0.0000	5.6000 out								
3380.000       0.0000       4.8000       eut         33840.000       0.0000       4.4000       eut         3420.000       0.0000       4.0000       eut         3420.000       0.0000       3.6000       eut         3420.000       0.0000       3.2000       eut         3420.000       0.0000       3.2000       eut         3520.000       0.0000       2.4000       eut         3540.000       0.0000       2.4000       eut         3540.000       0.0000       2.4000       eut         3540.000       0.0000       1.8000       eut         3630.000       0.0000       1.8000       eut         3780.000       0.0000       1.6000       eut         37440.000       0.0000       1.0000       eut         3820.000       0.0000       1.6000       eut         3820.000       0.0000       0.6000       eut         3820.000       0.0000       0.6000       eut         3940.000       0.0000       0.6000       eut         3940.000       0.0000       0.6000       eut         3940.000       0.0000       0.6000       eut <td< td=""><td>33120.000</td><td>0.0000</td><td>0.0000</td><td>5.2000 out</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></td<>	33120.000	0.0000	0.0000	5.2000 out								
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34260.000       0.0000       4.0000       automatic         34560.000       0.0000       3.6000       automatic         34520.000       0.0000       3.6000       automatic         35280.000       0.0000       3.2000       automatic         35400.000       0.0000       2.4000       automatic         35600.000       0.0000       2.4000       automatic         36360.000       0.0000       1.6000       automatic         36360.000       0.0000       1.6000       automatic         37380.000       0.0000       1.6000       automatic         37440.000       0.0000       1.2000       automatic         3880.000       0.0000       0.6000       automatic         38880.000       0.0000       0.6000       automatic         3940.000       0.0000       0.6000       automatic         39240.000       0.0000       0.2000       automatic	33840 000	0.0000	0.0000	4 4000 out								
3456,000       0.0000       3.600       cut         3450,000       0.0000       3.2000       cut         3528,000       0.0000       2.800       cut         3540,000       0.0000       2.4000       cut         3600,000       0.0000       2.0000       cut         3600,000       0.0000       2.0000       cut         3600,000       0.0000       1.8000       cut         37280,000       0.0000       1.6000       cut         3740,000       0.0000       1.2000       cut         3780,000       0.0000       0.0000       1.2000         3780,000       0.0000       0.0000       1.2000         3780,000       0.0000       0.0000       1.2000         3780,000       0.0000       0.8000       cut         3780,000       0.0000       0.0000       cut         3780,000       0.0000       0.0000       cut         3820,000       0.0000       0.0000       cut         3820,000       0.0000       0.2000       cut         38240,000       0.0000       0.2000       cut         39240,000       0.0000       0.2000       cut	34200 000	0.0000	0.0000	4 0000 out								
34220.000       0.0000       3.2000       cut         35240.000       0.0000       2.4000       cut         3540.000       0.0000       2.4000       cut         3640.000       0.0000       2.4000       cut         3640.000       0.0000       1.8000       cut         3630.000       0.0000       1.8000       cut         3630.000       0.0000       1.8000       cut         3780.000       0.0000       1.4000       cut         3780.000       0.0000       1.4000       cut         3780.000       0.0000       1.6000       cut         3780.000       0.0000       1.6000       cut         3780.000       0.0000       0.6000       cut         3880.000       0.0000       0.6000       cut         39240.000       0.0000       0.6000       cut         39240.000       0.0000       0.6000       cut         39240.000       0.0000       0.2000       cut         39240.000       0.0000       cut       cut         39240.000       0.0000       cut       cut         39240.000       0.0000       cut       cut         39	34560 000	0.0000	0.0000	3 6000 out								
15280.000       0.0000       2.8000       ut         15540.000       0.0000       2.0000       ut         16000.000       0.0000       2.0000       ut         16100.000       0.0000       1.6000       ut         16720.000       0.0000       1.6000       ut         16720.000       0.0000       1.6000       ut         17780.000       0.0000       1.2000       ut         17800.000       0.0000       1.2000       ut         18720.000       0.0000       0.0000       1.2000         18780.000       0.0000       0.0000       1.2000         18800.000       0.0000       0.8000       ut         18800.000       0.0000       0.8000       ut         18800.000       0.0000       0.6000       ut         18800.000       0.0000       0.6000       ut         18980.000       0.0000       0.6000       ut         18940.000       0.0000       0.6000       ut         18980.000       0.0000       0.6000       ut         18940.000       0.0000       0.6000       ut         18940.000       0.0000       0.6000       ut	34920 000	0.0000	0.0000	3 2000 out								
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Calendary have by the ball and a	Calcuration	time 406	.0000	sec.								
Calculation time 6.766667 min.	Calcuration	time 6.7	66667	min.								

On the menu bar, click [Open New 2D Post-Processing Window] icon

The [Post-processing Window (2D)] will open.



## **2** Visualizing the water depth

In the Object Browser, select [Nays2D Flood Grids] - [iRICZone] - [Scalar] - [Depth] by making a check mark in each box.

A contour map of water depth will open.



In the Object Browser, select [Nays2D Flood Grids] - [iRICZone] - [Scalar]. Right click on [Depth] to select [Property].

The [Scalar Setting] window will open.



On the [Scalar Setting] window, make the following settings and click on [OK]:

Color     Range       Presets:     [Please select ii ∨ ] Ignore Color bar setting when importing     Color Bar Setting       Relationship between values and colors     Visibility       ③ Automatically adjust based on value range     When selected ④ Always ○ Never       ○ Setup Manually     Offection:       Value Range     Horizontal ④ Vertical       □ Automatic     Horizontal ● Vertical       Max:     [5]       Min:     0.05       Colors     Label Display	Value range:
Presets:       (Please select ii ∨ ∠ Ignore Color bar setting when importing       Color Bar Setting         Petatorship between values and colors       Visibility	Value range:
Varue       Color         1       5         2       37625         3       2525         4       12875         5       005         005       005         Fill lower area       Fill upper area         Switch to Discrete Mode         Import       Export.	Remove ☑ from [Automatic] Max: 5 Min: 0.05 Remove ☑ from [Fill lower area] Colors: Do not change any settings Transparent: Do not change any settings. Color Bar Setting: Do not change any settings.

#### The contour map is easier to see now.



## **3** Visualizing flow vector

In the Object Browser, select [Nays2D Flood Grids] - [iRICZone] - [Arrow] - [Velocity]. In the Object Browser, select [Nays2D Food Grids] - [iRICZone] - [Arrow]. Right click on [Arrow] to select [Property].

The [Contour Setting] window will open.



#### On the [Contour Setting] window, make the following settings and click on [OK]:

Basic Color		
alue: Velocity(ms=1) ~		Length Legend
Length An	row Shape	Visibility
Auto Ar	row size: 8 🌻	O When selected  Always O Never
Standard value: 0.800000 🗘 [m/s] 📋	ne width: 1 🛢	Title
Length on screen: 40 🗣 [pixel]		Title : Velocity(ms=1)
Minimum value to draw: 0.00100000 🗘 [m/s]		Font Setting MS UI Gothic 11 pt Edit
Sampling		
O All vertices		Length
Sampling rate:		Format: %5.2f
I-direction 2 🛊		Font Setting: MS UI Gothic 11 pt Edit
J-direction 🧧 🖨		Color
Region		Title:
Full Region		Length:
Active Region		Background: 🛛 🗹 Transparent 🕂 80 🛊
Custom Region		Size and Pacifica
I Min:	1 🗘	Position Distance from data 150
I Max:	121 🗘	
(Min:	1	
I Man	1.01 *	
J Max:	Y IVI V	Height: 100 V

#### Length

Remove ☑ from [Auto]

Standard value: 8.00

Length on screen: 40

Minimum value to draw: 0.008

#### Sampling<sup>:</sup>

Sampling rate (Idirection): 2

Sampling rate (Jdirection): 2

#### Color:

Do not change any settings.

#### On the menu bar, Click [restart]

On the menu bar, Click [ )

Animated changes in inundation depth and flow vector will be displayed.



# To Reader

• Please reference the iRIC software, if you publish a paper with

results from the iRIC software.

• The datasets provided at the Web site are sample data. Therefore you

can use it for a test computation.

• Let us know your suggestions, comments and concerns at

## http://i-ric.org.

# i? iRIC Software

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