GUI Equipped user friendly debris flow simulator “Kanako 2D (Ver.2.02)” handy manual

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Topics

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- Main functions
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Modification from Kanako (Ver.2.01)-1

- After once simulation runned, some of parameters were not reset appropriately.
  - Therefore, in some condition the simulation result was not correct after once running the simulation.
  - The first simulation result seemed to be correct.

- We modified this issue.

Modification from Kanako (Ver.2.01)-2

- On 2 points on 1-D area downstream end and on 2-D upstream end area, for convenience of the integration model, if you move one, others will be interlocking.
- But in some cases, the interlocking being automatically-adjusted according to integration model was not proper.

- We modified this issue. When simulation starts, saving 1D river data, and setting 2D landform data, then 1D downstream end riverbed altitude will be automatically-adjusted.

We upgraded 2D Kanako to Ver.2.02,
but you can also read and use the Ver.2.01 Kanako 1D river data.

Modification from Kanako (Ver.1.02)

- The target is stony debris flow. Yet immature debris flow and bed load transport is also in the subject.
- You van change the material concentration .of supplied hydrograph.
- You can simulate from 1-D area to 2-D area by applying integration model.
- We consider only one grain size in Kanako 2D (Ver.2.01).
- Initial movable bed layer can be set on 1-D area from 0m to 10 m range, on 2-D area from 0m to 20 m range..

- When you start running simulation or save the input data, hydrograph observation points and sabo dams are set in numerical order from the upstream end automatically.

Composing files in Kanako 2D (Ver.2.01)

- When you start ‘kanako’, 4 data files and exe file must be set in the same folder. Data files are ‘defaultwk’ 1-D landform and simulation variables, ‘wadako2-z’ 2-D movable bed altitude, ’wadako2-zs’ 2-D fixed bed altitude,’wadako2-id’ 2-D calculation flag.
- And it is better to keep these 4 setting file unchanged, so when you want to change some parameters, please copy and make another file.

- After starting, you can read or save files following the normal procedure for reading or saving data.

Reading, saving, and modifying the landform data

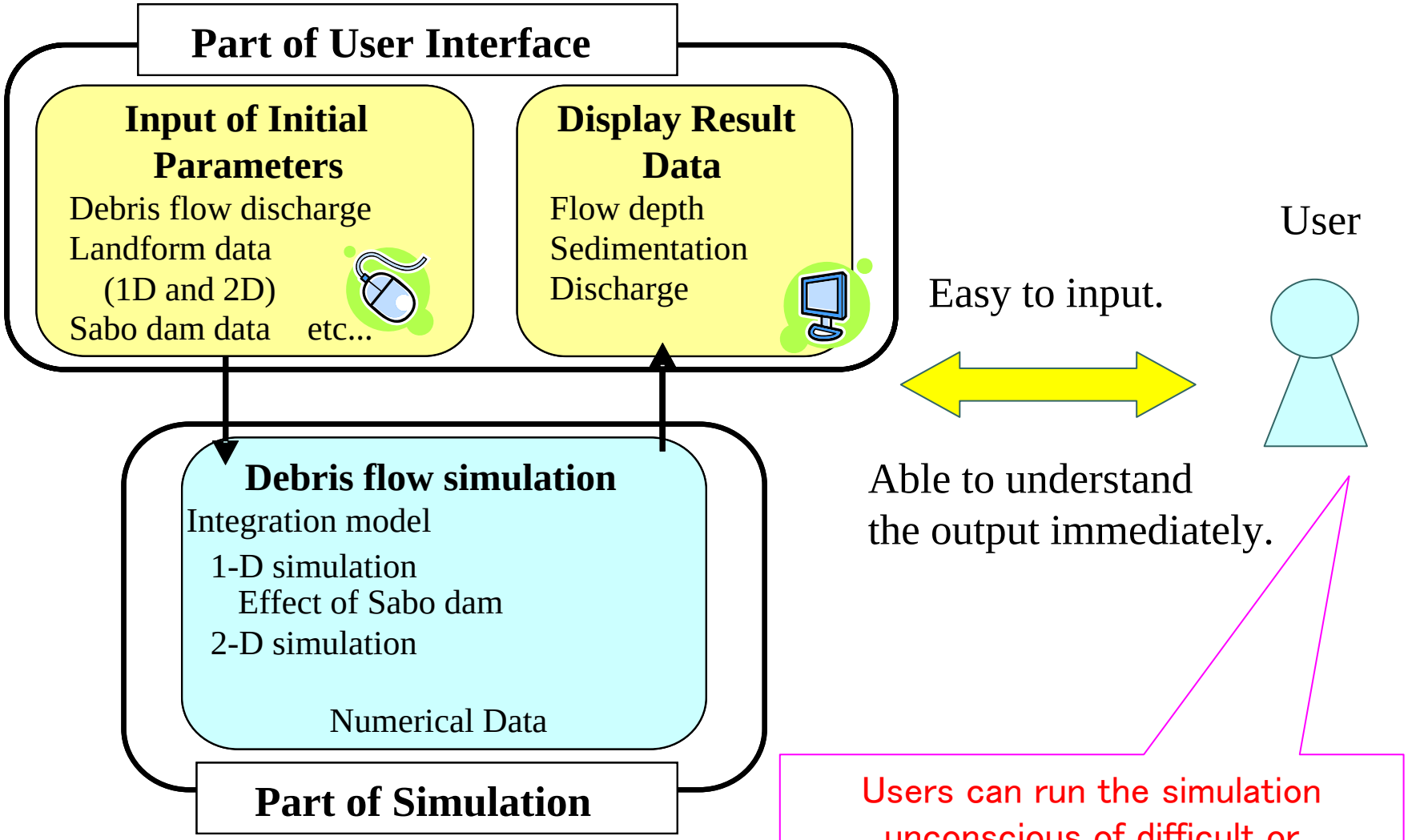
- You can save or read the setting data as DAT. or CSV. format.
- You can change the numerical values in the data file directly.
- You can also change the parameters using in the simulation (ex: Manning's roughness coefficient, coefficient of erosion or deposition rate, simulation continuance time, interval of calculation points, time interval of calculation, etc.)
- In Kanako 2D
  - 1-D landform (+ supplied hydrograph, valuables necessary for simulation) data and 2-D landform (fixed bed and movable bed altitude, calculation flag) data are set separately. You can not set or save all together.
  - In initial setting, 3 data files as following 'wadako2-zs','wadako2-z','wadako2-id' are required for 2-D landform setting. But after once you start up "Kanako" and save or call 2-D landform, fixed bed altitude, movable bed altitude, and calculation flag (0:skip calculation, 1:execute calculation) data is gathered to 1 data file.
  - Number of calculation grid is set as 60×60(non changeable)

When changing numerical values from file,
please see the details from "Kanako Ver.1.10 handy manual".

Necessary software

- **Microsoft .NET Framework Version 1.1 or newer version**
- Sometimes, PC on Windows XP, kanako can not start. And almost that happens because the version of .NET Framework is old or not installed.
- Maybe error message as following will be displayed.
  ″mscoree.dll could not be found″, ″mscoree.dll could not be loaded″
- In this case, please install NET Framework1.1. or the newer version.
- To install ″NET Framework″, go to Microsoft website, and download ″Microsoft .NET Framework Version Redistributable Package″

System outline

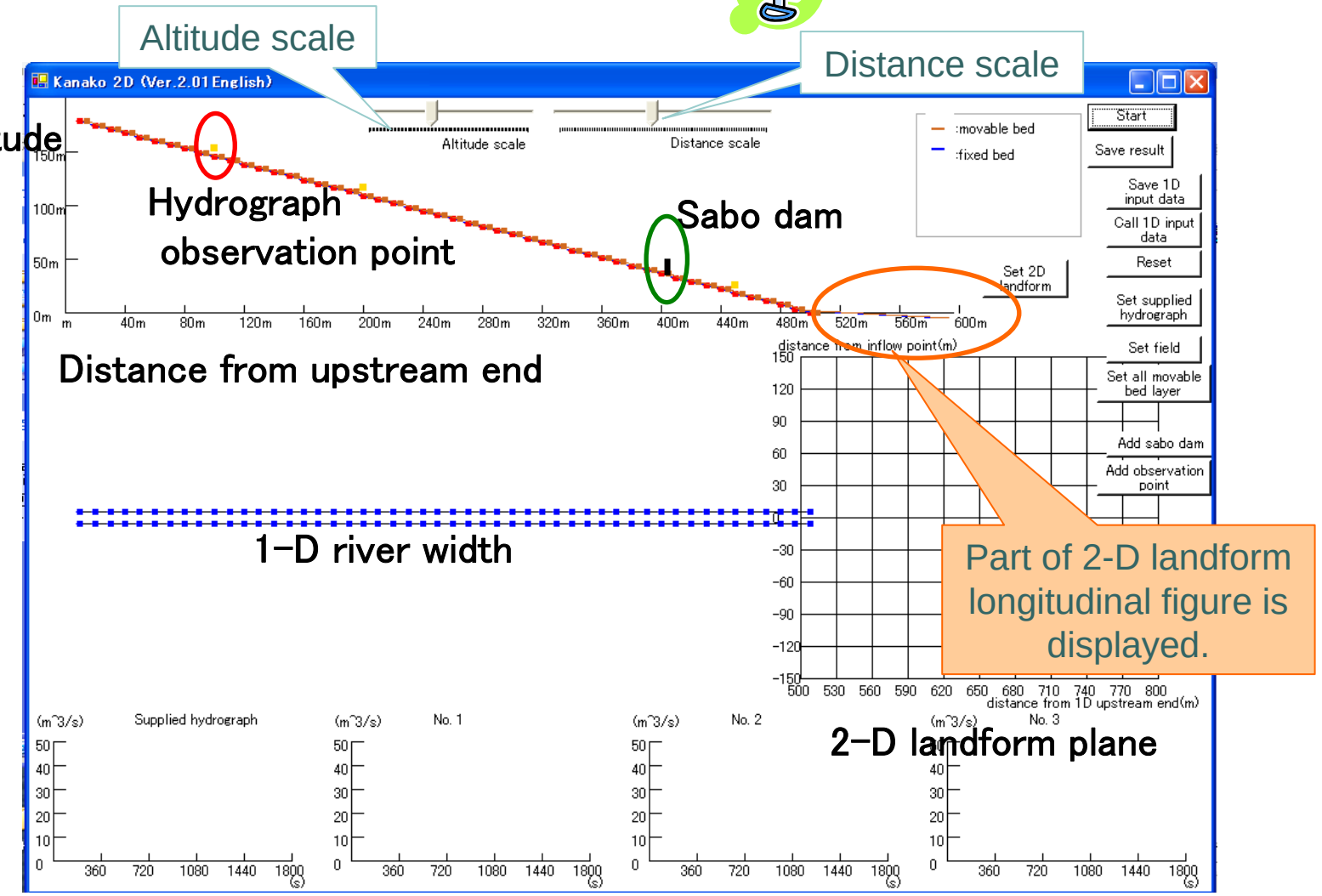


Input main functions in Kanako 2D (Ver.2.01)

	Function details	Explanation
Input	1-D landform	Vertical section on steep gullies
	2-D landform	Plane figure on alluvial fans
	Sabo dam	Type/height/location/number (1-D)
	Sabo structure	Area/location (2-D)
	Hydrograph observation point	Number/location (1-D)
	Supplied hydrograph	Input flow and concentration of debris flow
	Initial movable bed layer	Thickness of movable layer before simulation
	Field	Number of calculation points
	Save/Open data	Save/Open all input data

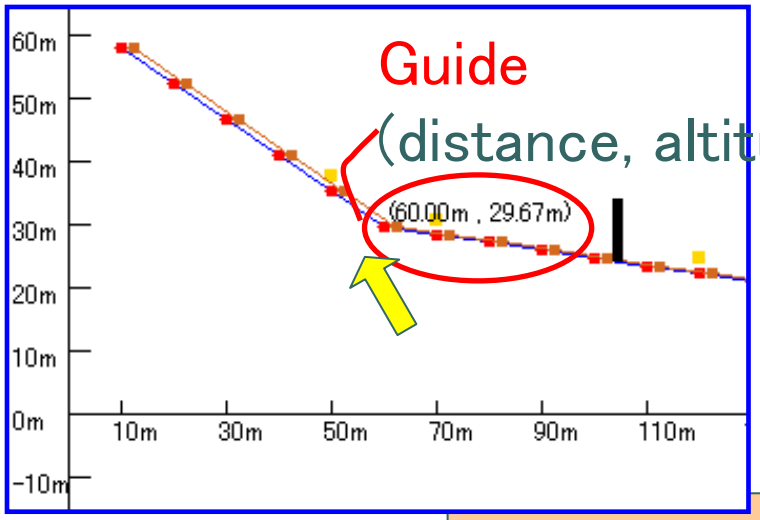
Input (1)

Parameters can basically be input using mouse and checked on monitor.



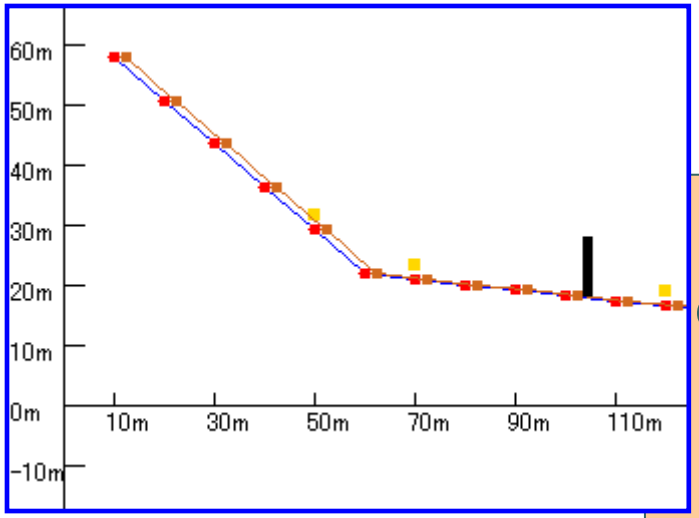
Start screen (1-D landform setting)

Input(2)



Guide
(distance, altitude)

While dragging



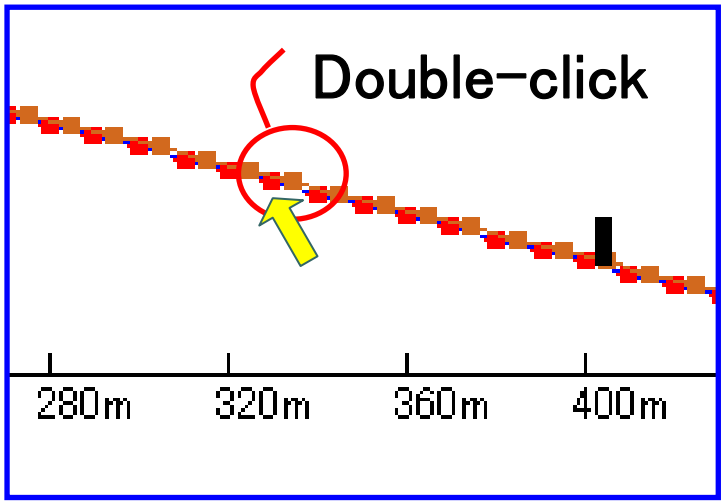
Stop dragging (River profile changed)

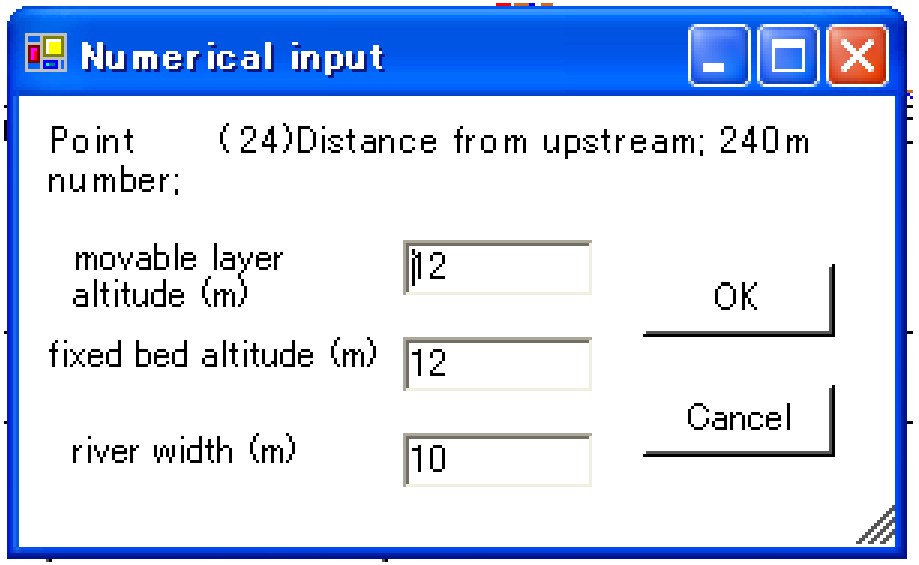
:movable bed

:fixed bed

・You can change the river profile, and supplied hydrograph by dragging the point by mouse.
・While dragging, the guide shows the current point position.

Input(3)

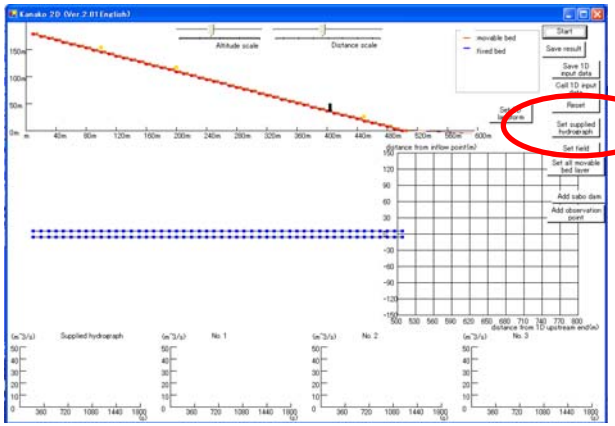




Numerical input screen

・You can also change the landform by double-click the setting point, opening the “Numerical input” screen.

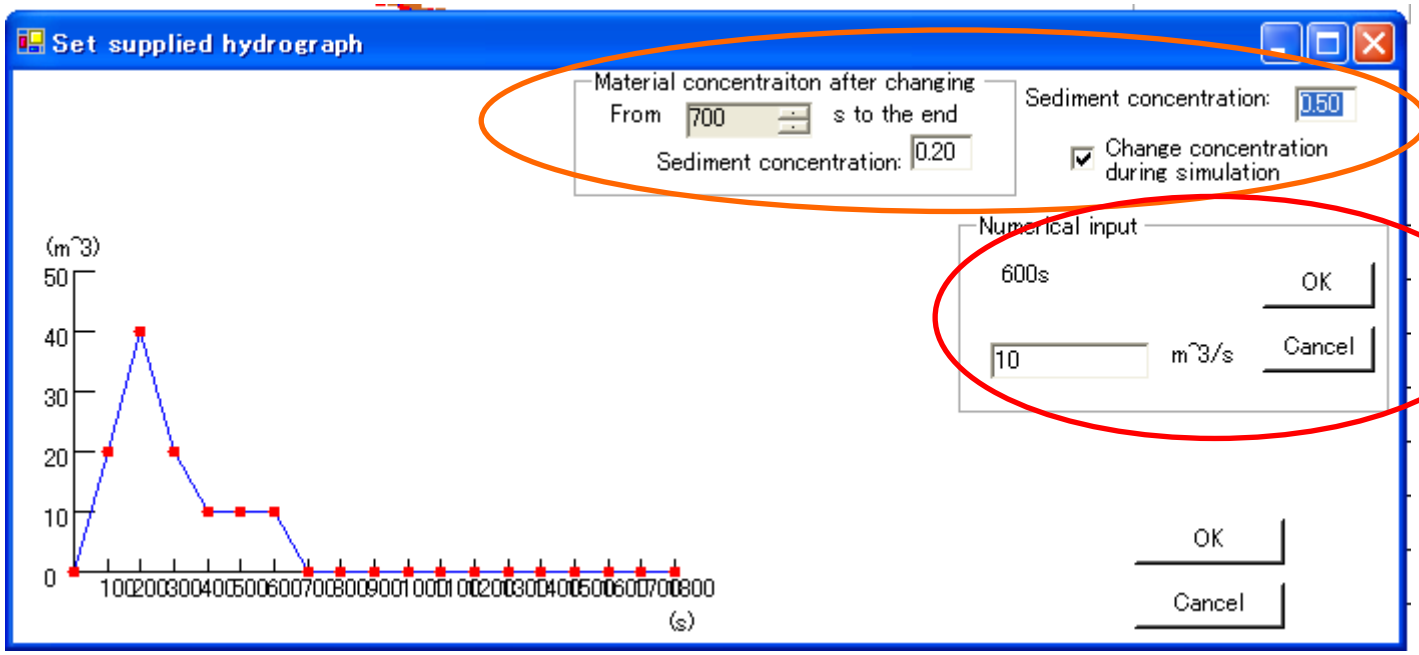
Input(4)



Click and open "Supplied hydrograph" screen

・To change the discharge, drag red points.
・To set detail discharge, double-click the point and input numerical value.

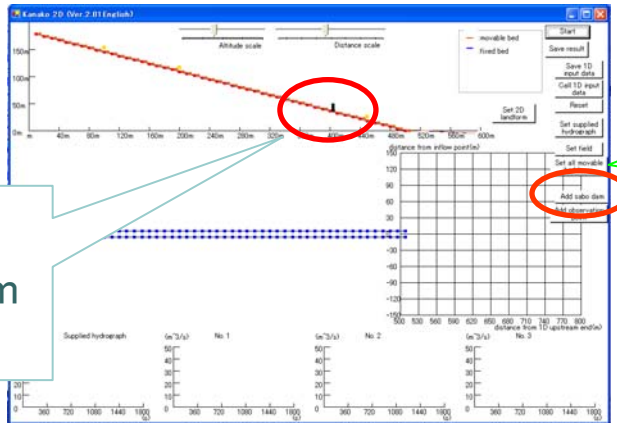
Set sediment concentration
cf1.You can change sediment concentration once during the simulation.
cf2.When changing, check the box and set "Changing time" and "concentration after changing"



Set supplied hydrograph screen

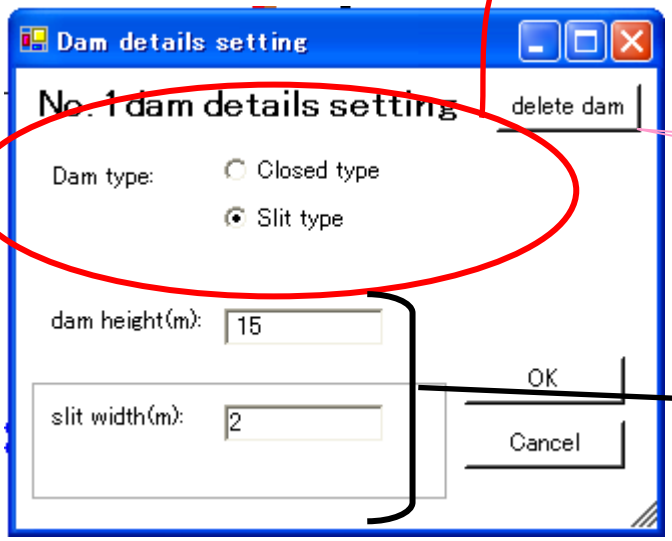
Input(5)

Double-click the setting “sabo dam” and open “Dam detail setting” screen.



When you want to add dam, click “Add sabo dam” button then dam will be added on random position.

Select the dam type by radio button; closed, or slit type.

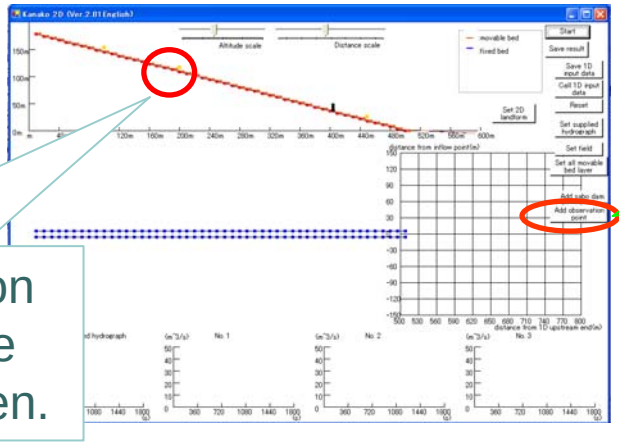


When deleting dam, click here.

To set the height and slit width of dam, input data to the text box.

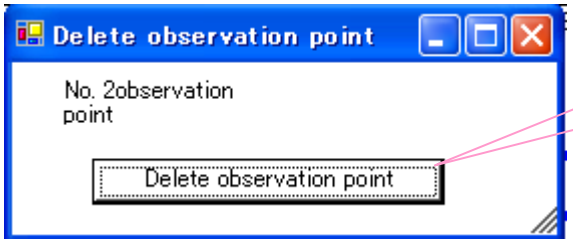
Dam details setting screen

Input(6)



Double-click observation point and open “Delete observation point” screen.

When you want to add observation point, click “Add observation point” button then it will be added on random position.

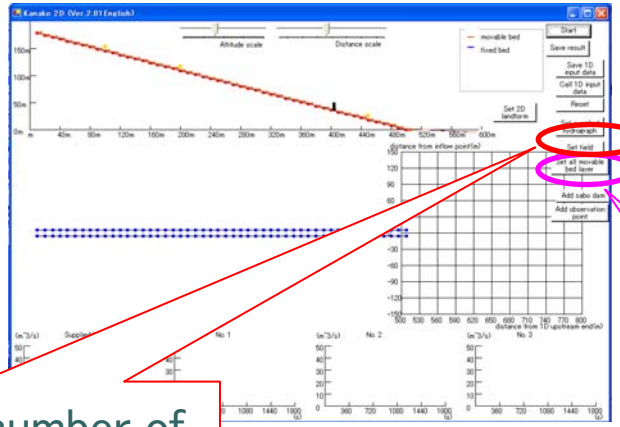


When deleting observation point, click here.

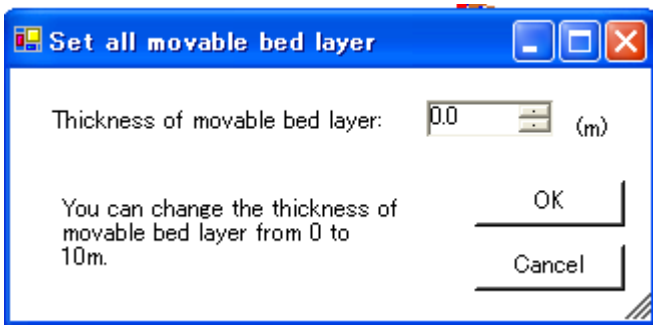
Delete observation point screen

During the simulation, hydrograph will be displayed in the bottom of screen. The first graph on the most left is the data of supplied hydrograph (whole discharge, coarse material discharge, fine material discharge) at the most upstream, others are hydrograph in each observation points.

Input (7)

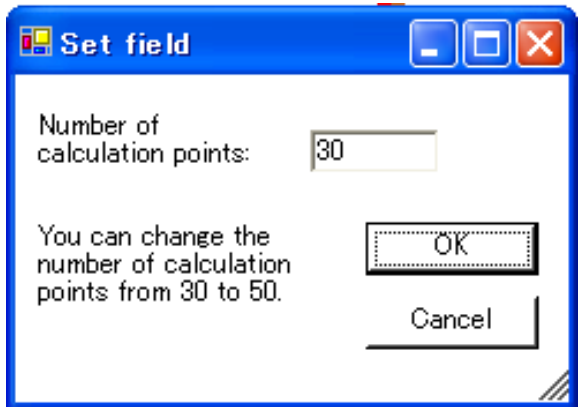


To change the number of calculation points, click “Set field” button.



Set all movable bed layer screen (Range from 0m to 10m.)

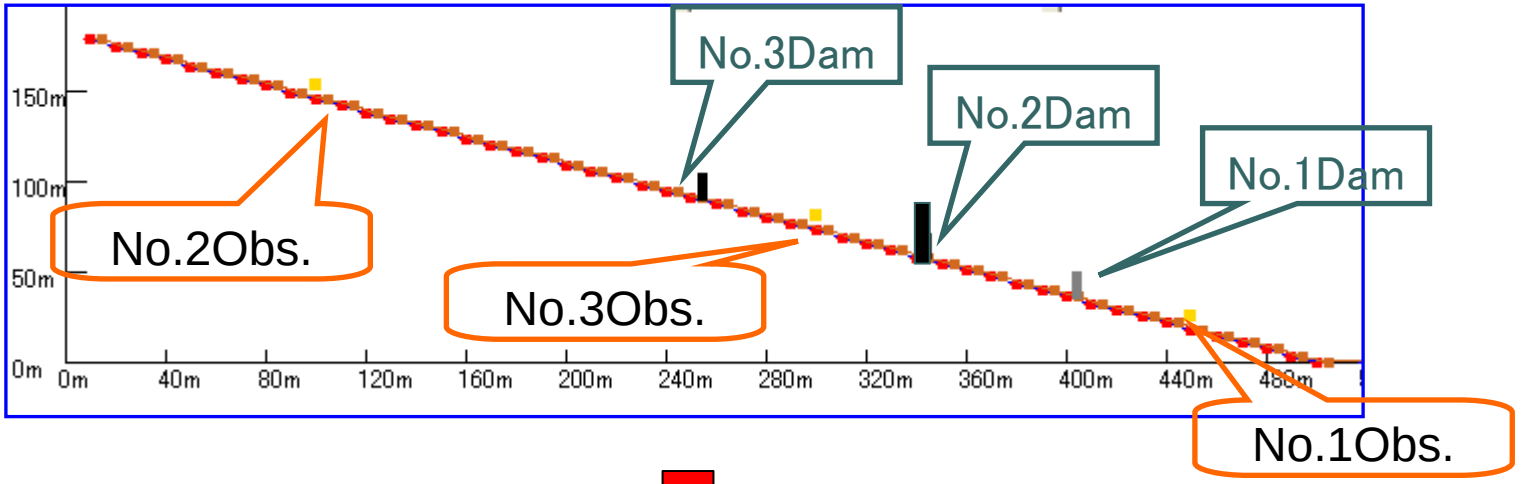
To change the thickness of movable bed layer, click “Set all movable bed layer” button.



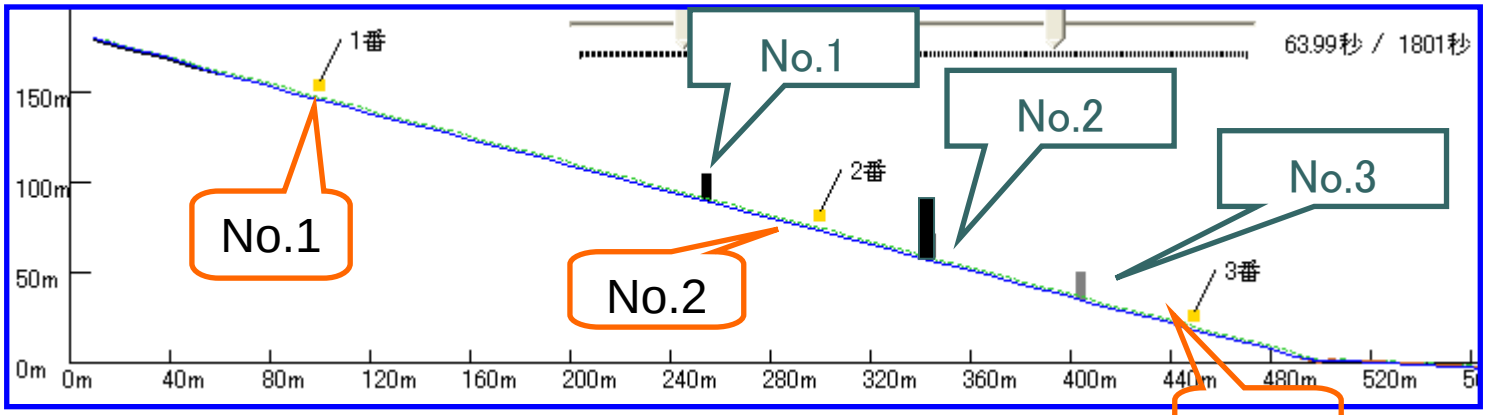
Set field screen (Range from 30 to 50.)

When dam or observation point is not set in numerical order from upstream;

Before simulation



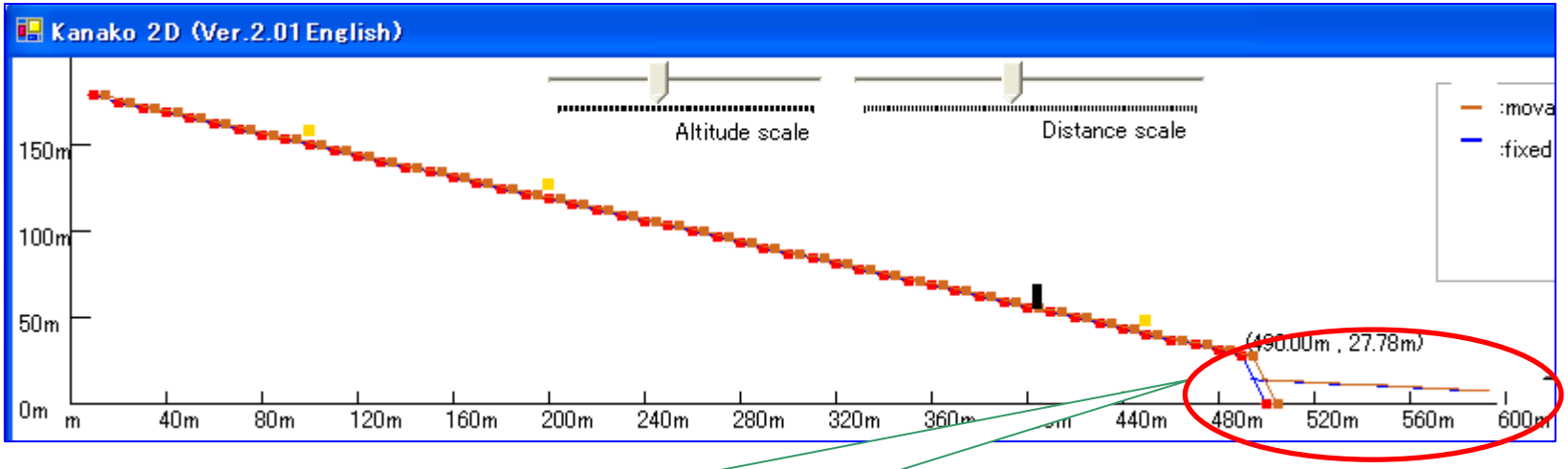
After starting simulation



After you start running simulation or save the input data, hydrograph observation points and sabo dams are set in numerical order from the upstream end automatically

Other notices

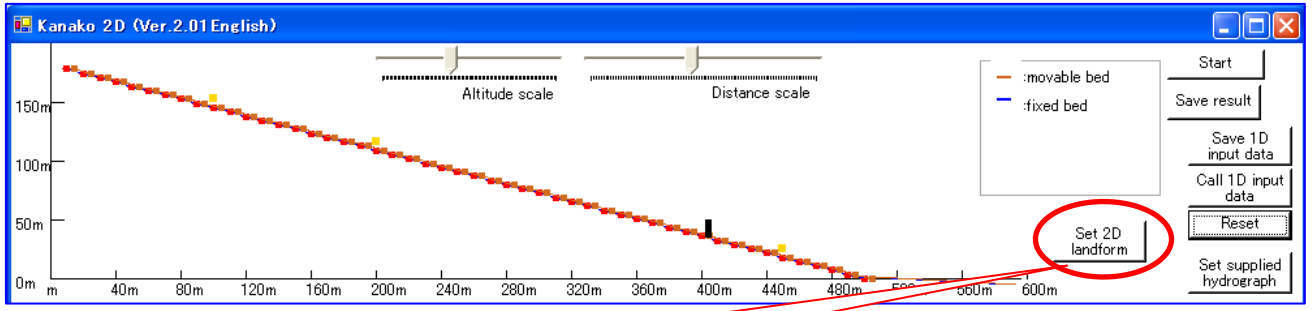
1. You cannot set sabo dam on 1-D downstream end.
2. You cannot set observation point just before the sabo dam.
3. On 2 points on 1-D area downstream end and on 2-D upstream end area, for convenience of the integration model, if you move one, others will be interlocking. see the following figure.
4. 1-D downstream end point and 2-D upstream end area are virtual point and area for simulation.



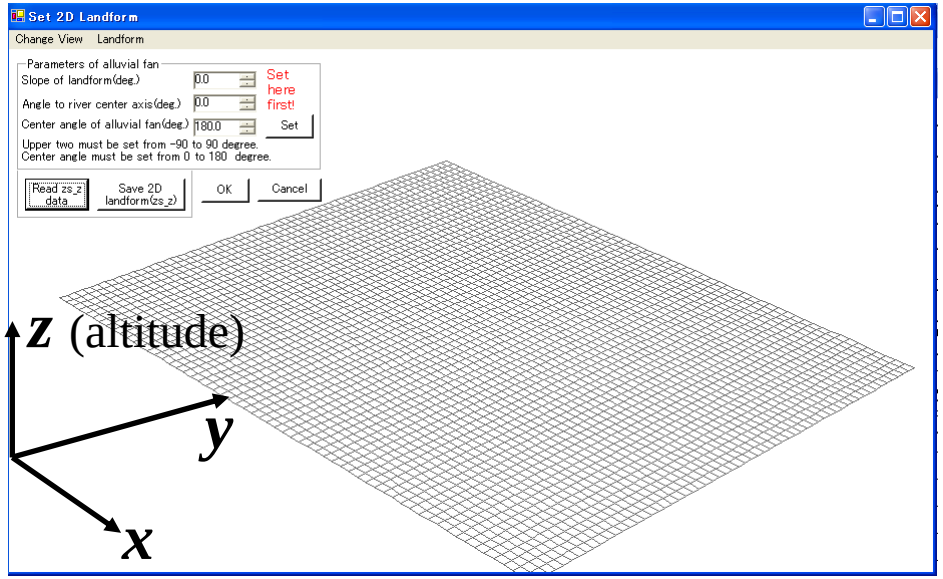
When dragging 2nd downstream end point in 1-D area, the 1-D downstream end point and 2-D plane will be interlocking

To see the detail, please refer to the “Integration model” reference.

2D landform setting



To set, click “Set 2D landform” button.



Please notice that 2-D landform displayed here is fixed bed altitude and is not movable bed altitude.

2D landform setting screen on initial setting

Input(8)

When setting 2-D landform, please set these 3 alluvial fan parameters first!

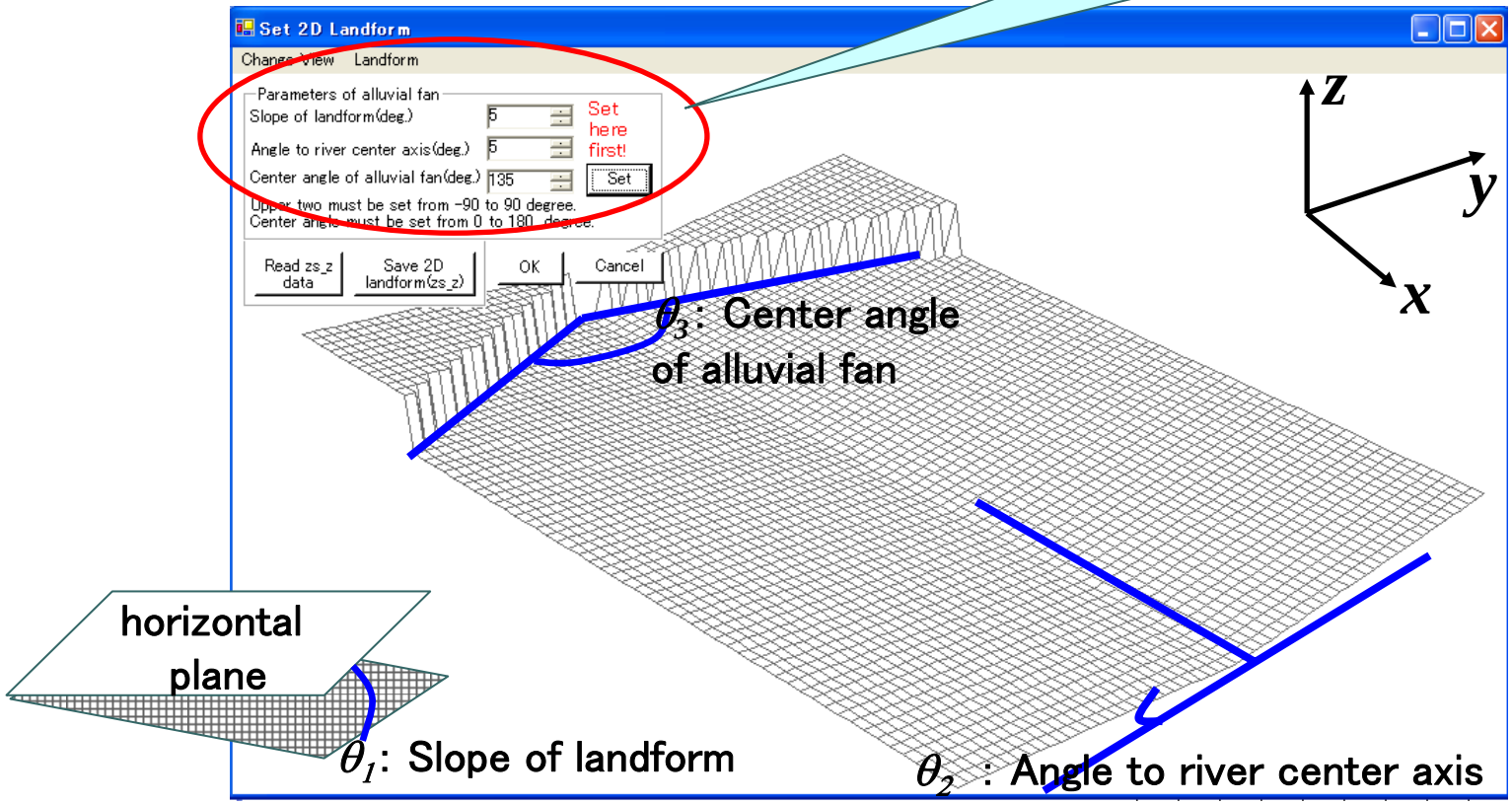
To set alluvial fan, we need 3 parameters

1.Slope of landform (θ_1)

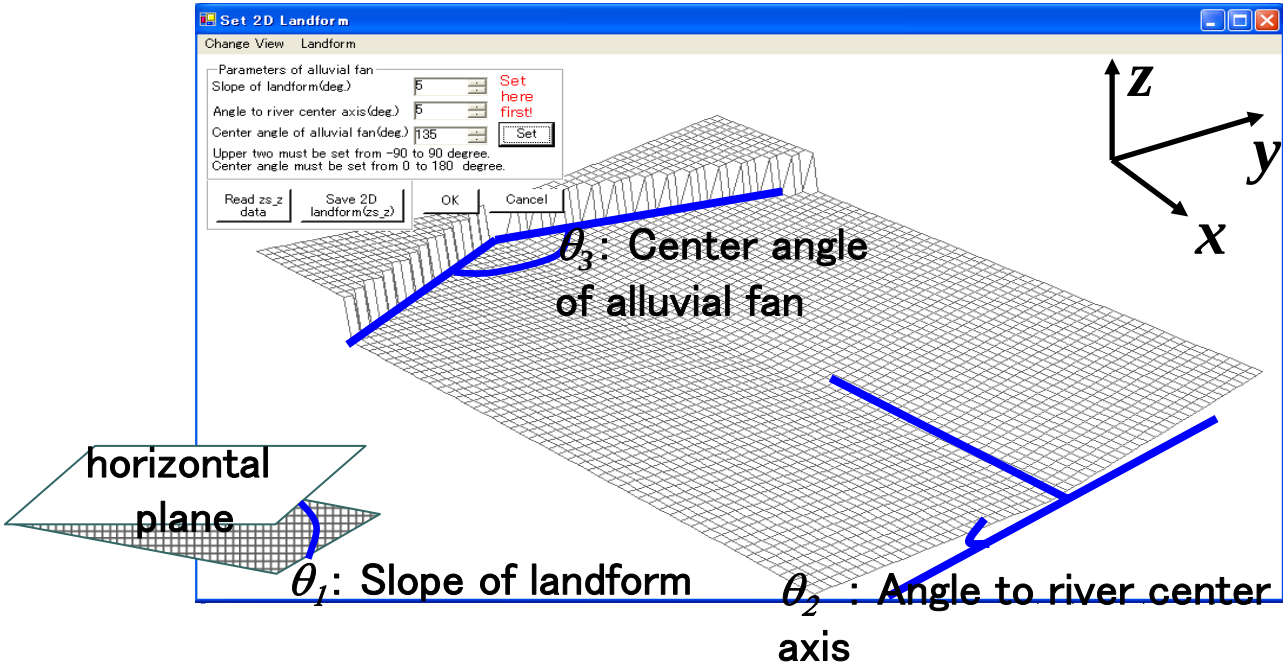
2.Angle to river center axis (θ_2)

3.Center angle of alluvial fan (θ_3)

Set these using this control.



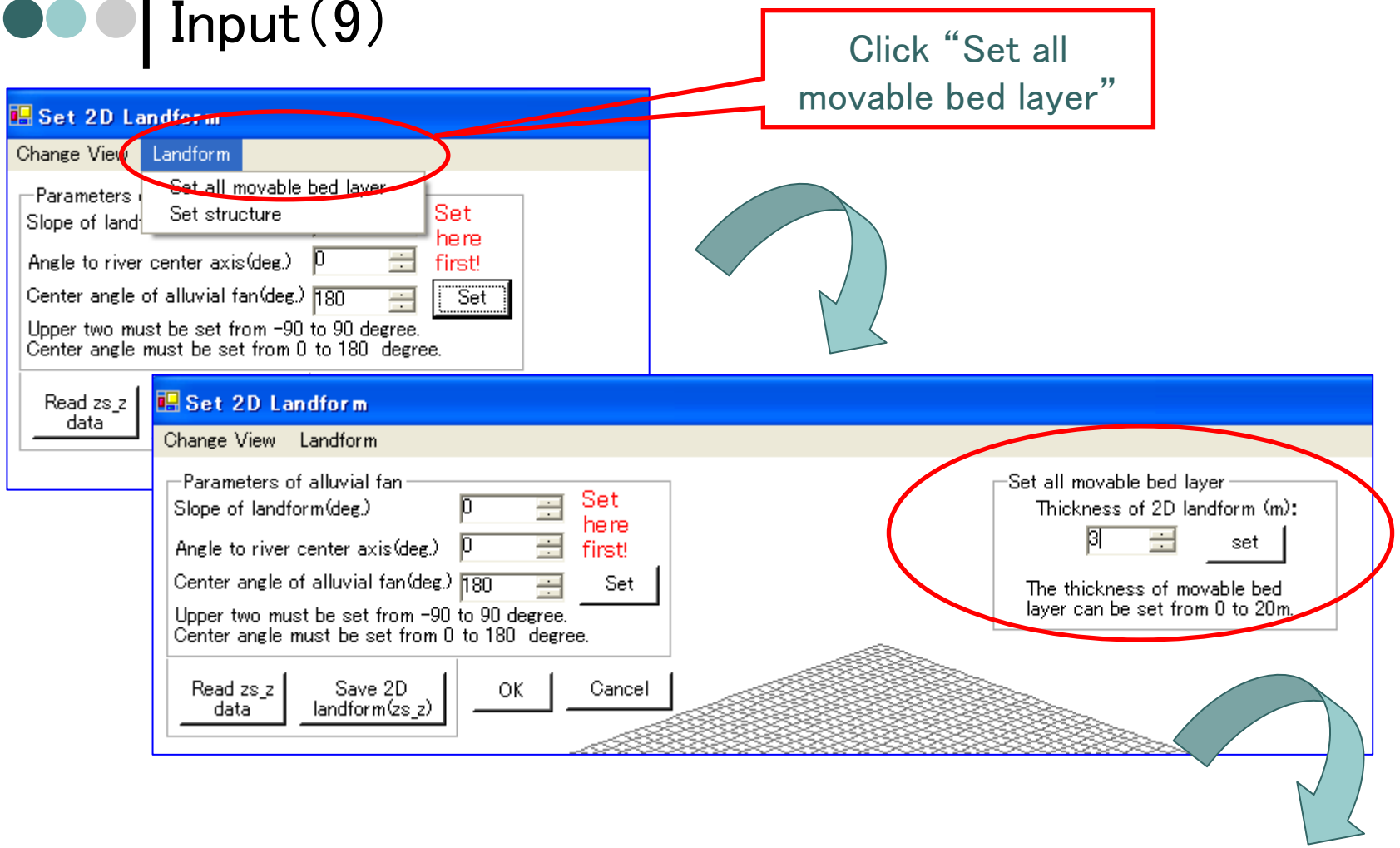
2D landform setting screen



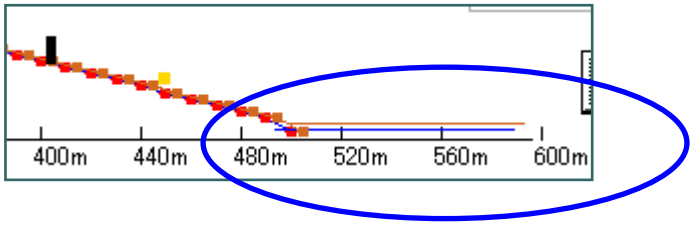
Initial condition of 2D landform is shown as bellow.

Parameter	Range	Unit	Initial value
Slope of landform （Θ_1)	$-90 < \Theta_1 < 90$	deg	0
Angle to river center axis (Θ_2)	$-90 < \Theta_2 < 90$	deg	0
Center angle of alluvial fan(Θ_3)	$0 < \Theta_3 = < 180$	deg	180
Thickness of movable bed layer	min:0、Max:20	m	0

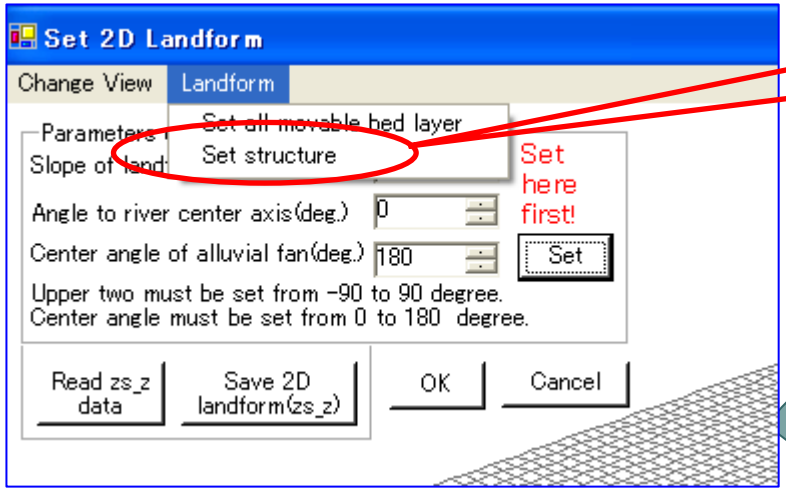
Input (9)



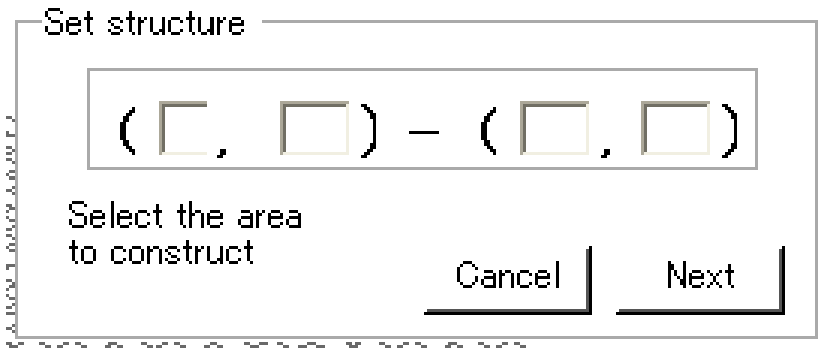
Notice that you can not see the change of movable bed layer on 2D landform screen, but you can see on 1D landform (main) screen.



Input(10-1)

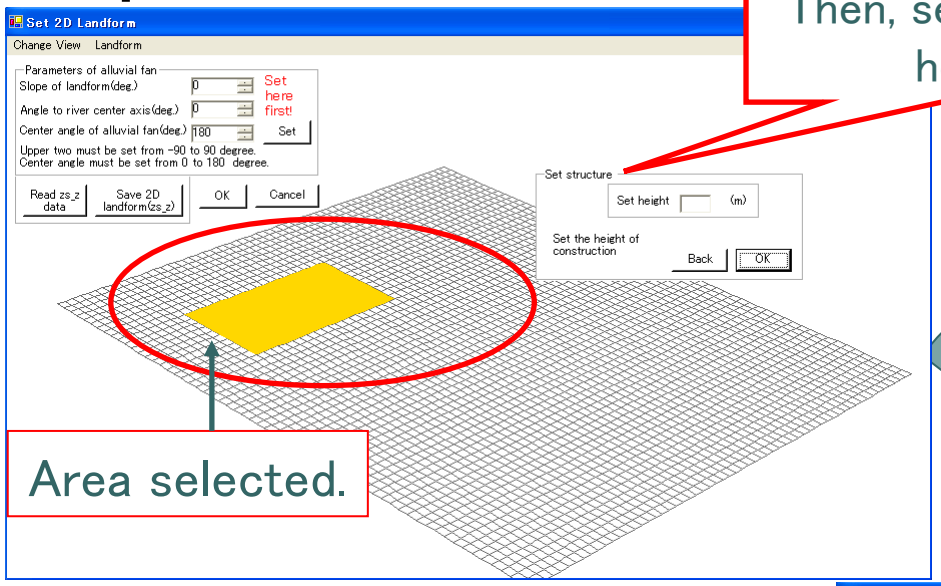


Click “Set structure”



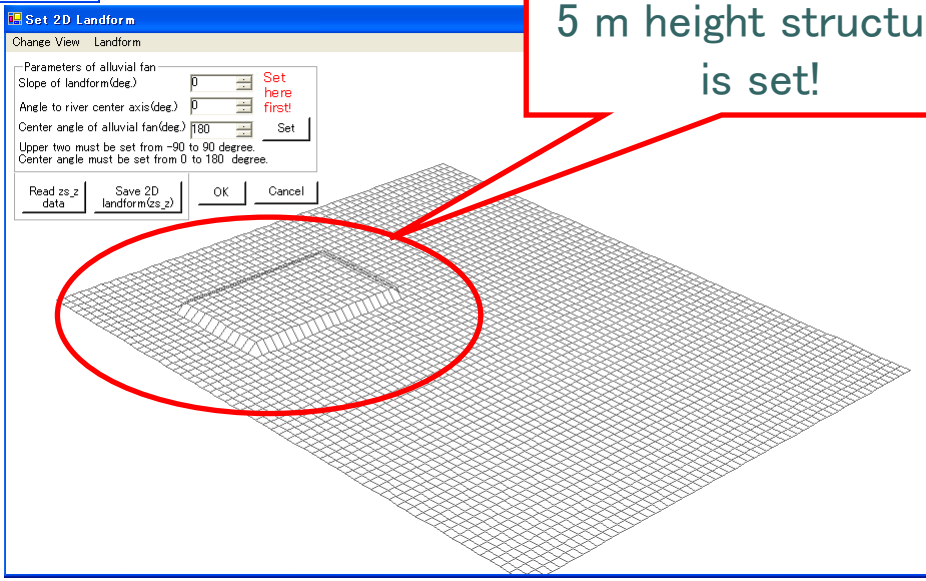
Set the area to brackets from (1,1)–(60, 60) range.

Input (10-2)



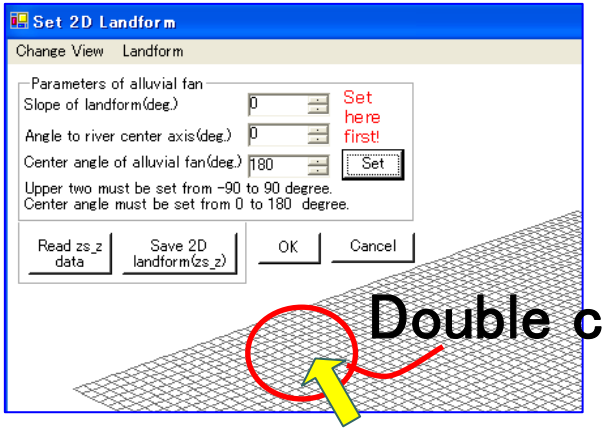
Then, set structure height.

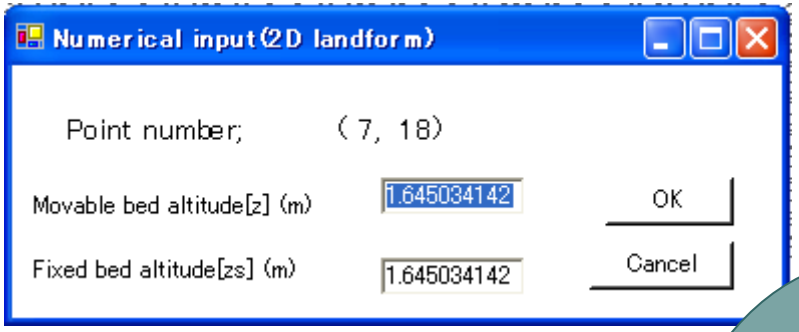
Area selected.



5 m height structure is set!

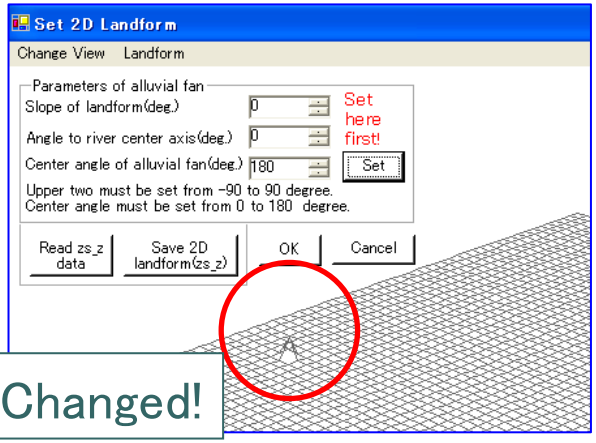
Input (11)





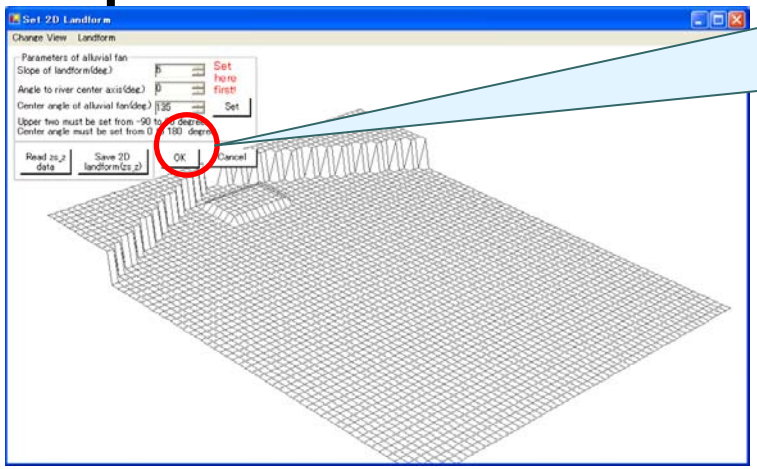
Numerical input (2D landform) screen

→Here, set both movable bed and fixed bed as 10 m;

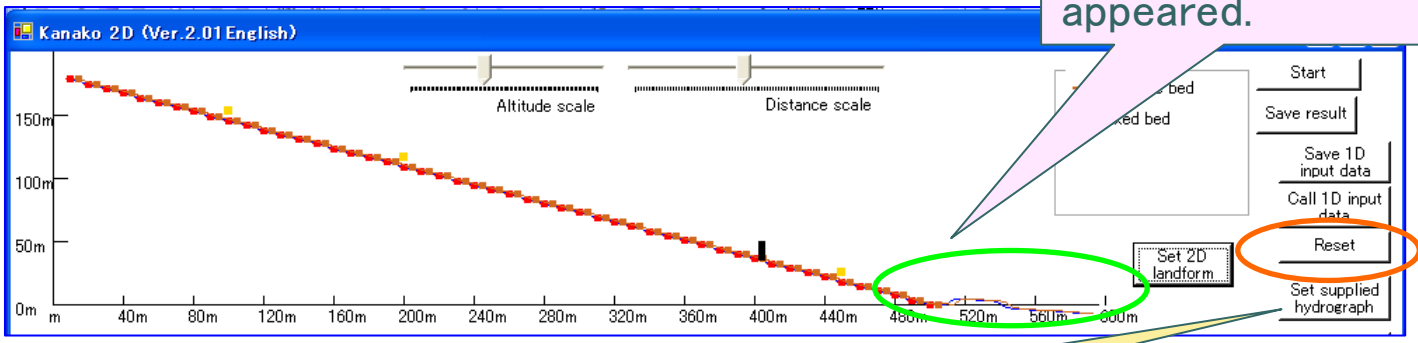


·In 2D landform, you can set detail landform by double clicking and open “Numerical input” screen , then input numerical values.

After setting 2D landform data, click “OK” button. Then “2D setting” screen closes, and the input value will be set for the simulation.



Data set in 2D landform screen is appeared.

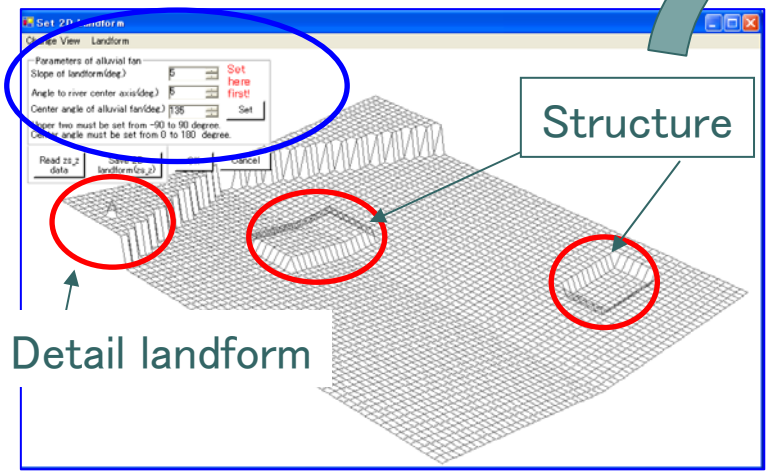


Notice !

If you click “Reset” on 1D main screen, also 2D landform will be reset.

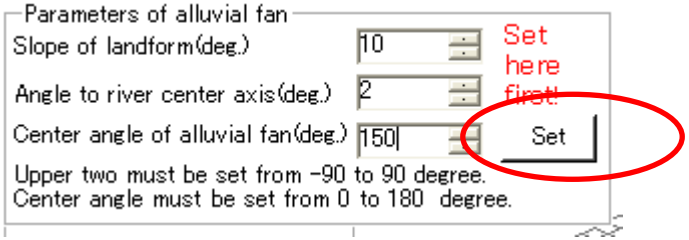
Notice

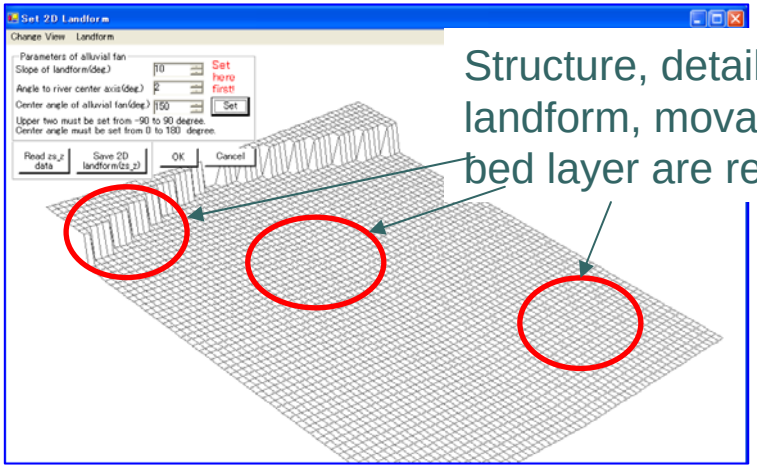
When setting 2-D landform, please set these 3 alluvial fan parameters first!



・Movable bed layer 2m

If you set alluvial fan parameters after setting structures, movable bed layer, detail landform

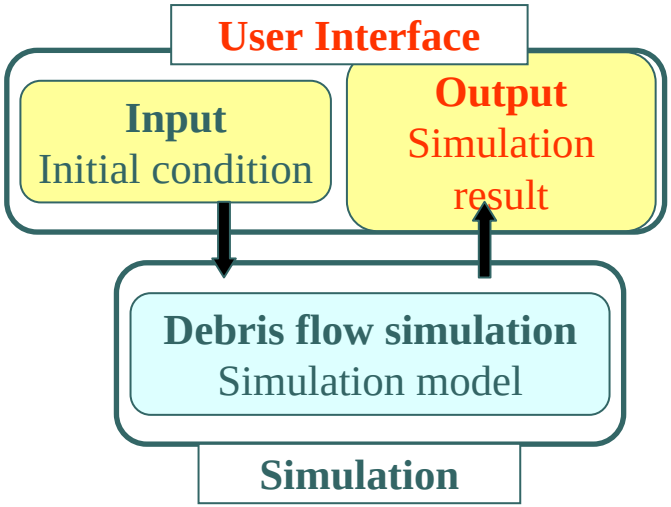




・Movable bed layer 0m

Every setting data is reset, and then alluvial fan is set.

Output main functions in Kanako 2D (Ver.2.01)



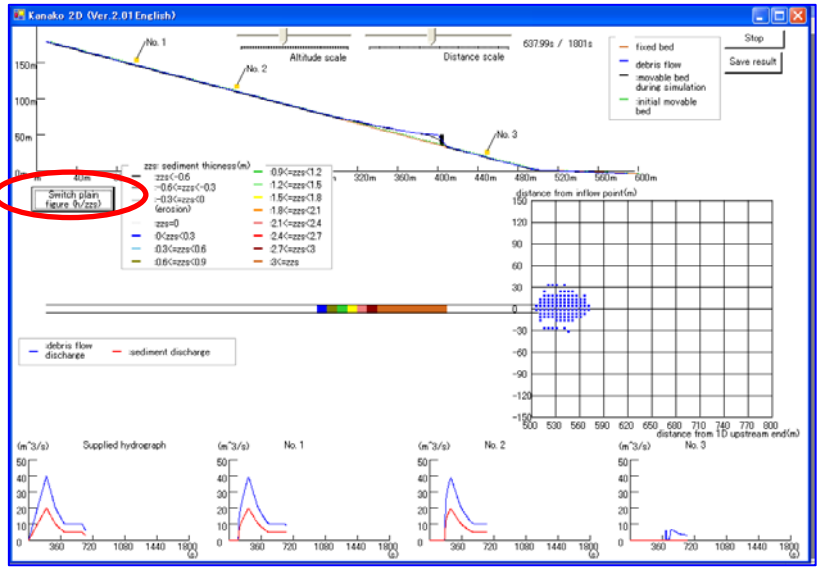
When simulation begins,
simulated debris flow is initiated and sediments move down from the upper stream.

During simulation, two screens are displayed; one is the main screen and the other is 2-D landform screen.

	Function details	Explanation
Output	Display real-time animation during simulation (simplified display)	Display flow depth, sedimentation thickness initial bed on 1-D and 2-D landform
		Display discharge at each observation point
	Save result after simulation	Save detail result data of simulation

・Sedimentation thickness variation shows the difference from the initial bed condition.

Output



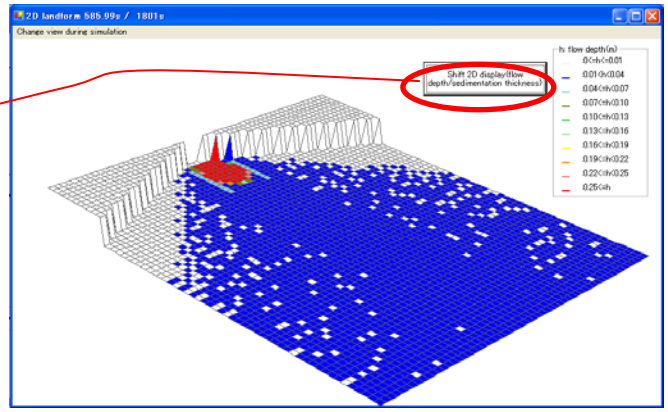
Simulation screen (Main screen, plane figure showing sedimentation thickness)

It animates real-time image of flow depth, moving bed surface, initial bed surface, and fixed bed in the longitudinal figure.

It shows the flow depth and sedimentation in the plain figure.

It represents hydrograph and sediment graph, supplied from the upstream end and at each observation point.

You can see flow depth or sedimentation thickness on the 1D plain figure and 2D landform screen, switching each display by clicking the button.



2-D Simulation screen (Showing flow depth)

During the simulation, you cannot close 2D landform screen!

Save result

- To save result, click the “save result” button after the simulation.
- In every sixty seconds, at all the calculation points (both 1D and 2D), following results can be saved.
- 1D result (Point number; flow depth, sediment concentration, flow velocity, bed surface altitude, movable bed thickness variation from the initial bed)
  - Different from Kanako（Ver.1._ ,1D only, ） you cannot save discharge.
  - Hydrograph and sediment graph show on main screen is just for display during simulation.
- 2D result (In numerical order of point; flow depth, sediment concentration, flow velocity u [flow direction], flow velocity v [cross direction], bed surface altitude, movable bed thickness variation from the initial bed)
  - In 2D result, numerical order of point is shown as bellow.

(1,1), (1,2), (1,60),
(2,1), (2,2), (2,60),
～
(60,1), (60,2), (60,60)

  - The result display is shown as bellow.

0 s flow depth
60 s flow depth
–
1800 s flow depth
0 s sediment concentration
– –
1800 s sediment concentration
– – –
1800 s movable bed thickness variation from the initial bed

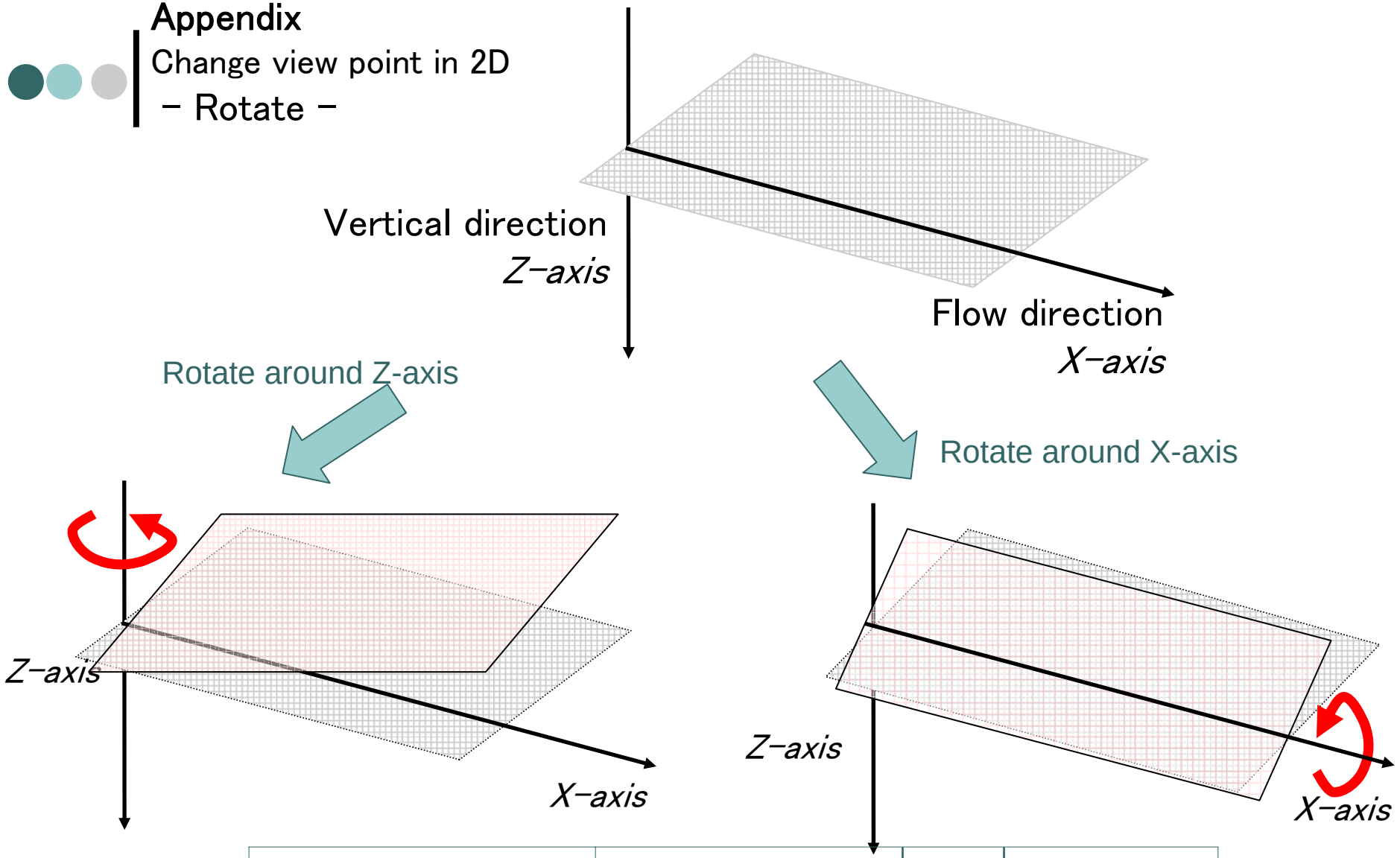
Reference

- Wada, T., Satofuka, Y., Mizuyama T. (2008), Integration of 1- and 2-dimensional models for debris flow simulation, Journal of the Japan Society of Erosion Control Engineering, Vol.61, No.2, pp.36-40 (in Japanese with English abstract).
- Nakatani, K., Satofuka, Y., Mizuyama, T.(2007), Development of 'KANAKO', a wide use debris flow simulator equipped with GUI, Proc. of 32nd Congress of IAHR, Venice, Italy, CD-ROM, 10p, A2.c-182.
- Nakatani, K., Wada, T., Satofuka, Y., Mizuyama, T.(2008), Development of 'KANAKO', a wide use 1-D and 2-D debris flow simulator equipped with GUI, Monitoring, Simulation, Prevention and Remediation of Dense Debris Flows, WIT Transactions on Engineering Sciences, Volume 60, pp.49-58
- Satofuka, Y., Mizuyama T. (2005), Numerical simulation of a debris flow in a mountainous river with a sabo dam, Journal of the Japan Society of Erosion Control Engineering, Vol.58, No.1, pp. 14-19, (in Japanese with English abstract).
- Satofuka, Y., Mizuyama, T. (2006), Numerical simulation of debris flow control by a grid dam, Proc. of the 6th Japan-Taiwan Joint Seminar on Natural Hazard Mitigation, CD-ROM.
- KanakoVer.1.10 Handy manual(You can download from the "The Online Library of Civil and Environmental Engineering" for free; search "kanako" in software)
  - http://www.olcivil.com/Site/index.php

Appendix

Change view point in 2D

– Rotate –

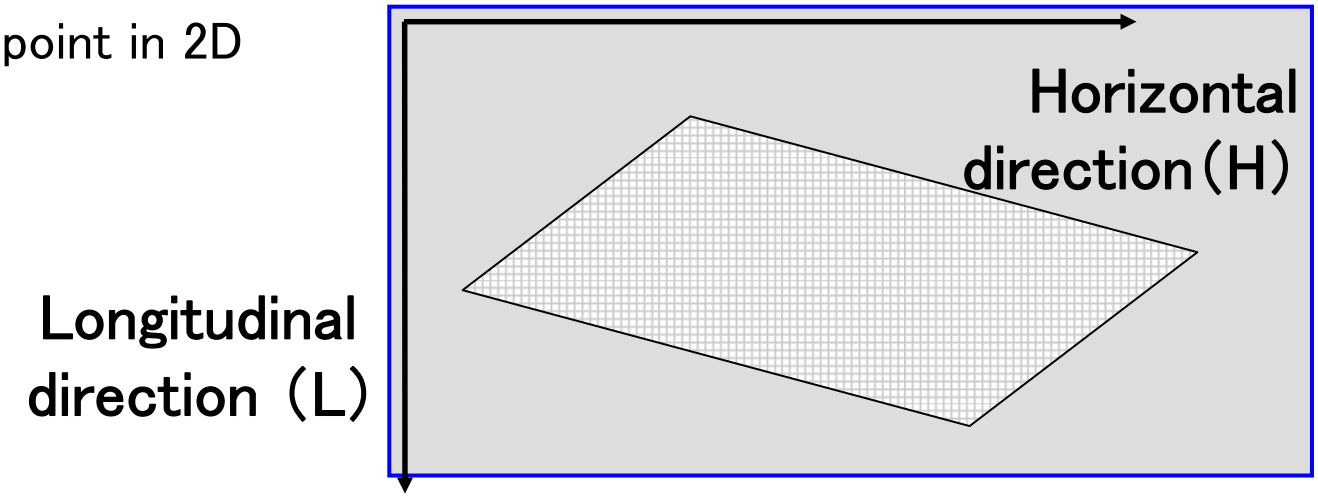


Parameter	Range	Unit	Initial value
Z-axis rotation angle	$-180 =< \Theta < 180$	deg	-50
X-axis rotation angle	$-180 =< \Theta < 180$	deg	25

Appendix

Change view point in 2D

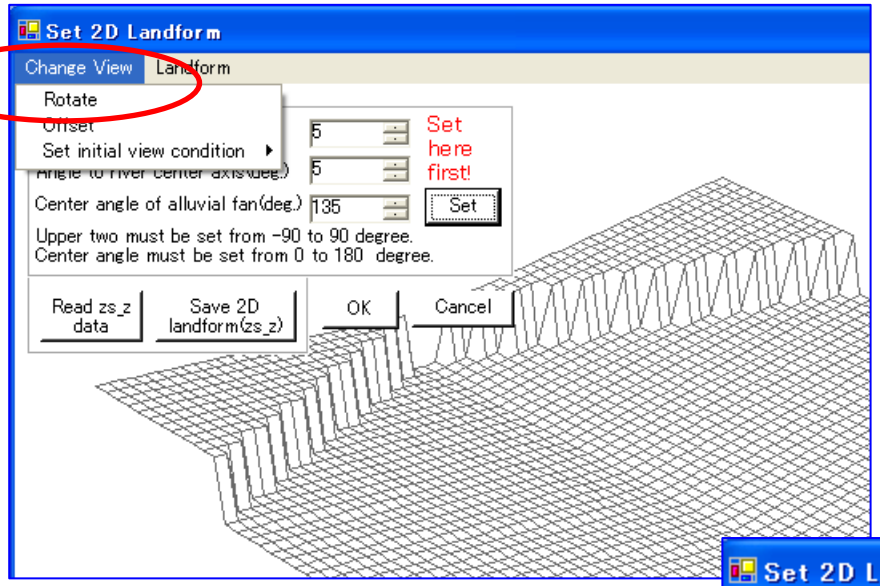
– Offset –

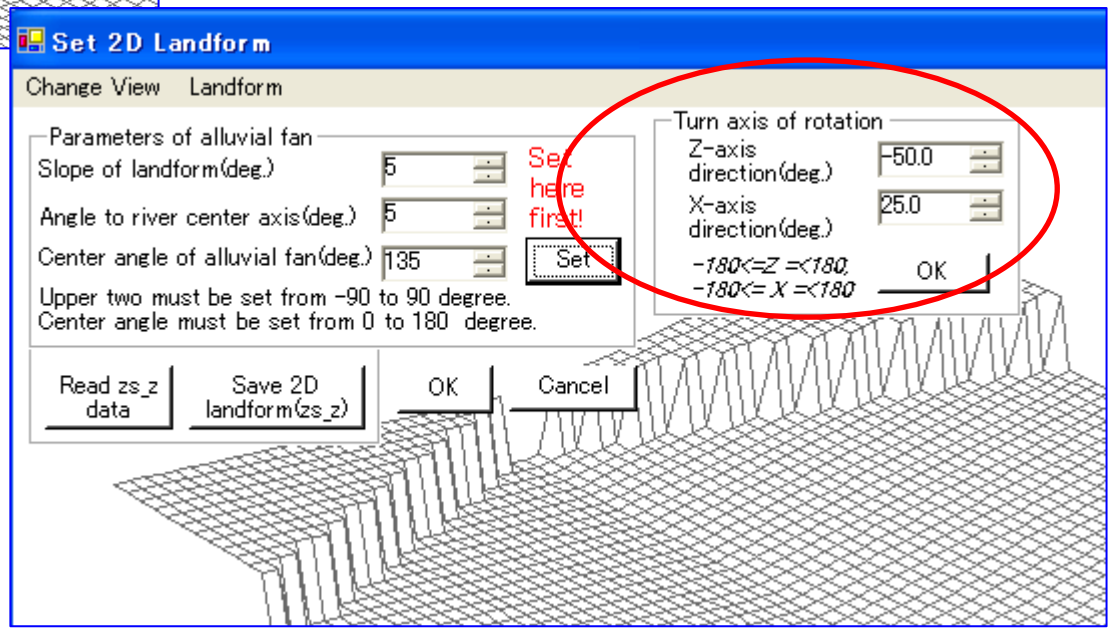


Parameter	Range	Unit	Initial value
Longitudinal direction (L)	min:−50, Max:500	px	250
Horizontal direction (H)	min:−200, Max:700	px	50

Change view(1-1)
- Rotation -

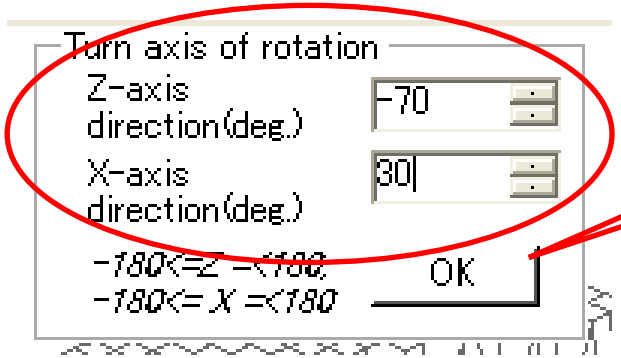
To change view, set
- Rotation
- Offset

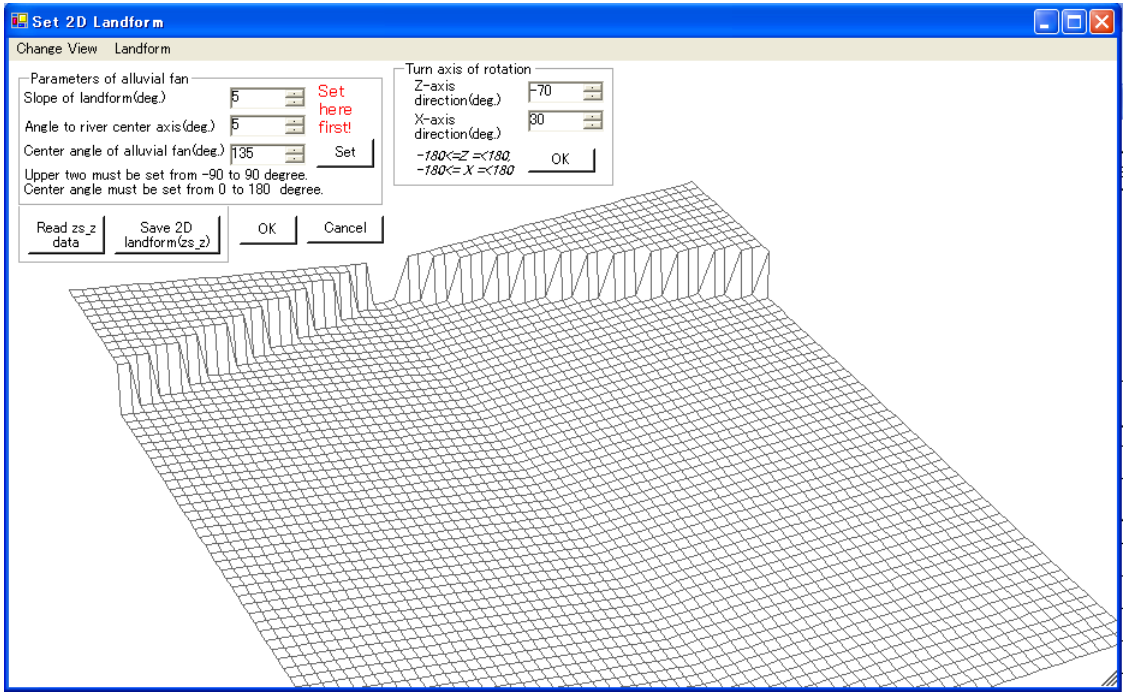




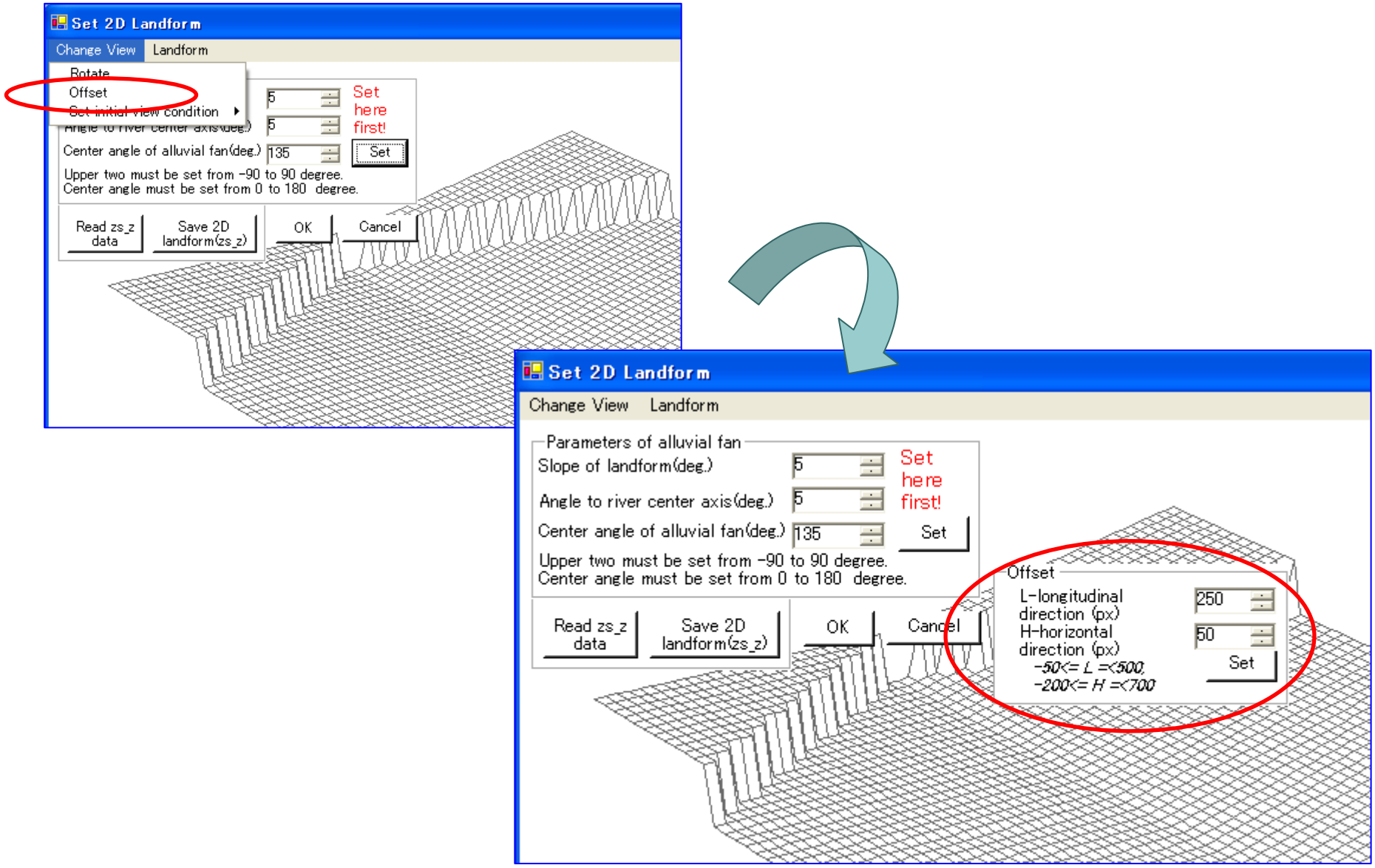
Change view(1-2)

Click “OK”, then view will be changed as following.



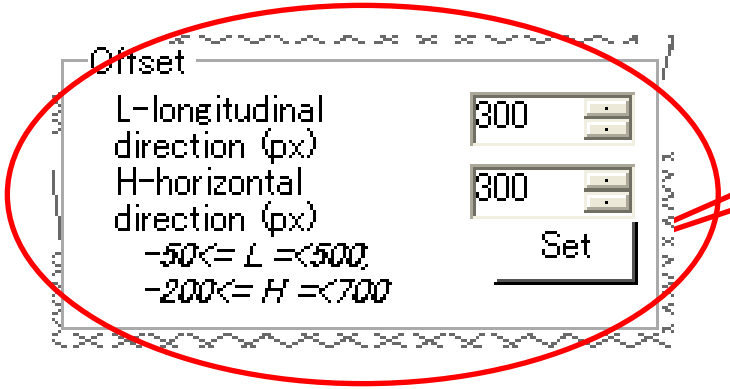


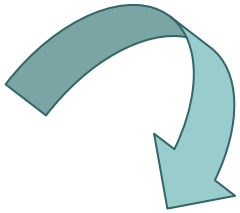
Change view(2-1)
- Offset -

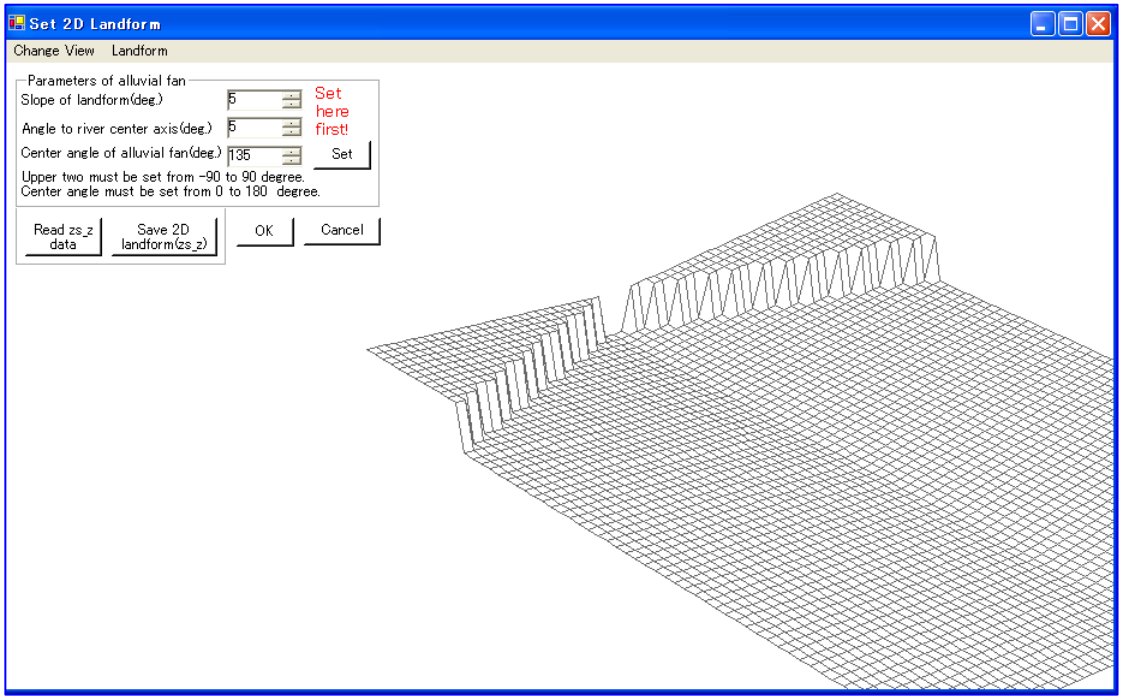


Change view(2-2)

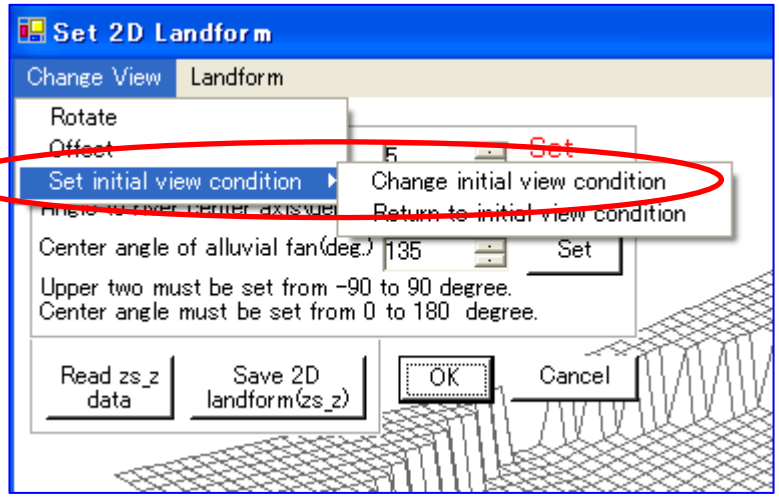
Click “OK”, then view will be changed as following.





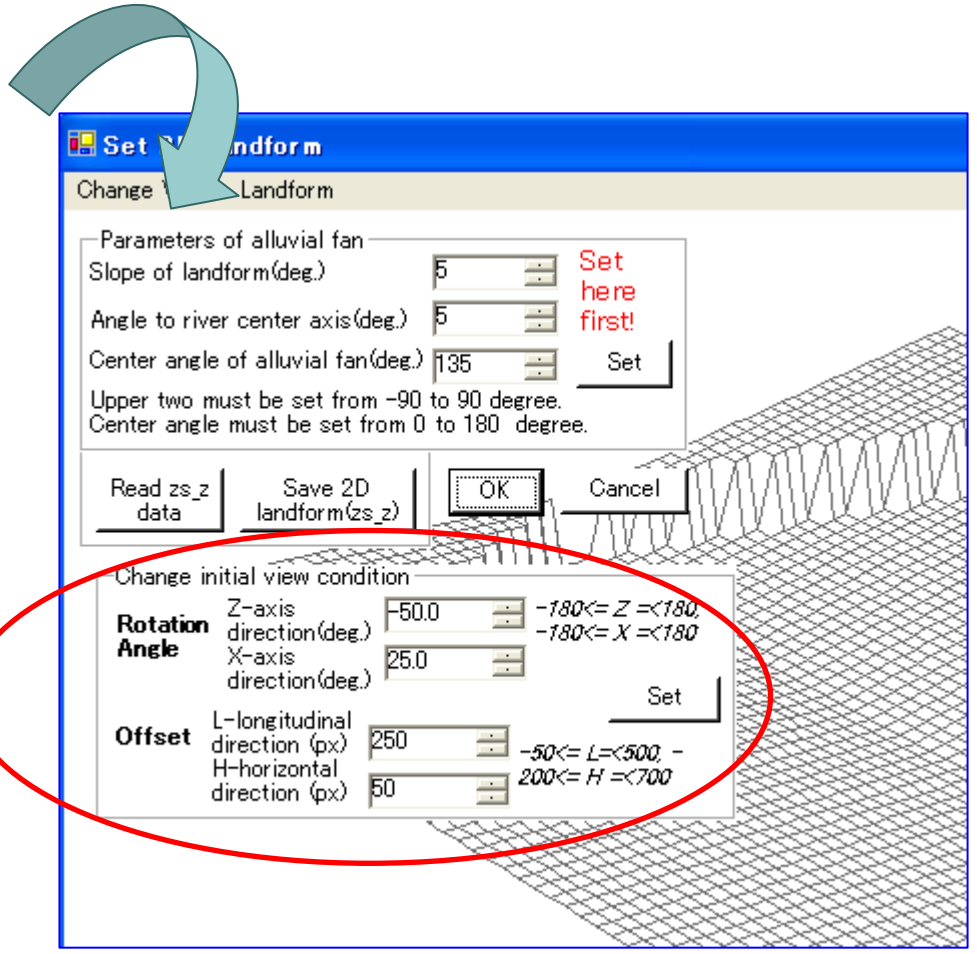


Change view(3-1)



You can set initial view condition.
While setting landform data or during simulation, if you select “Return to initial view condition”, and you can return to the initial condition immediately.

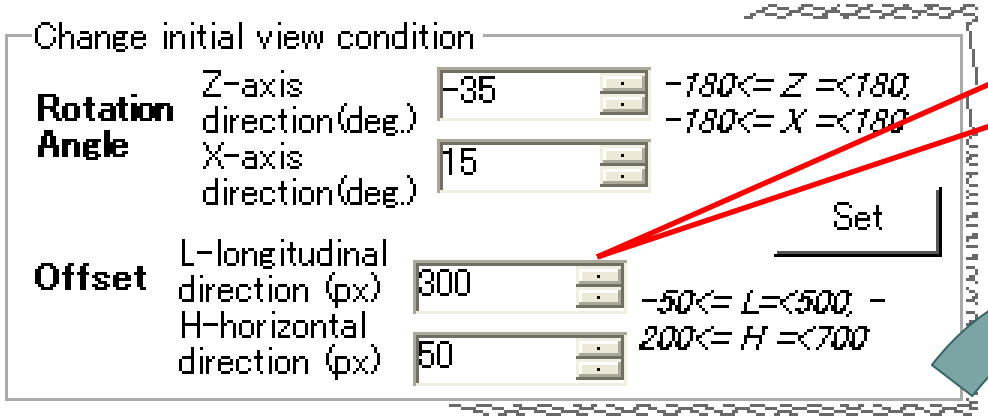
How to set is same as “Change view”.

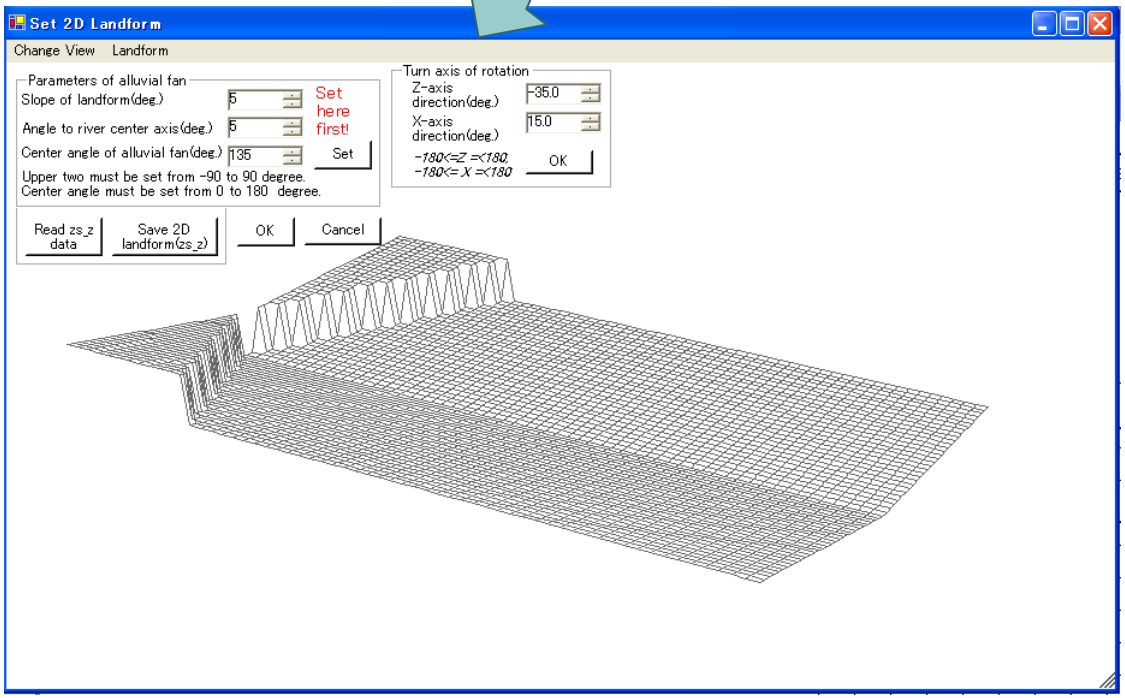


In default, initial view condition is set as shown.

Change view(3-2)

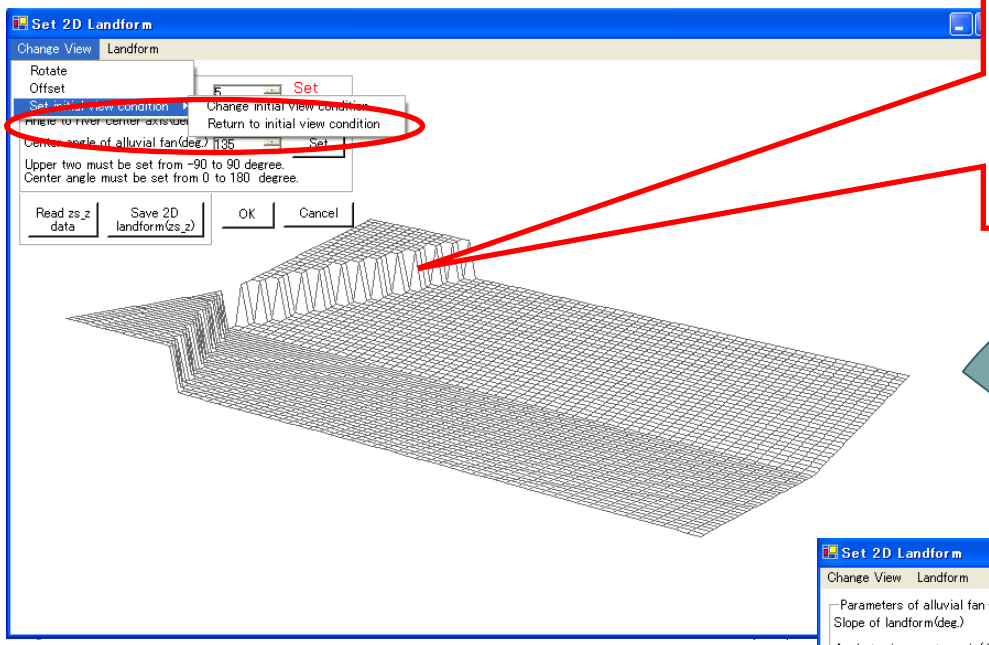
Click “OK”, then view and also initial condition will be changed.

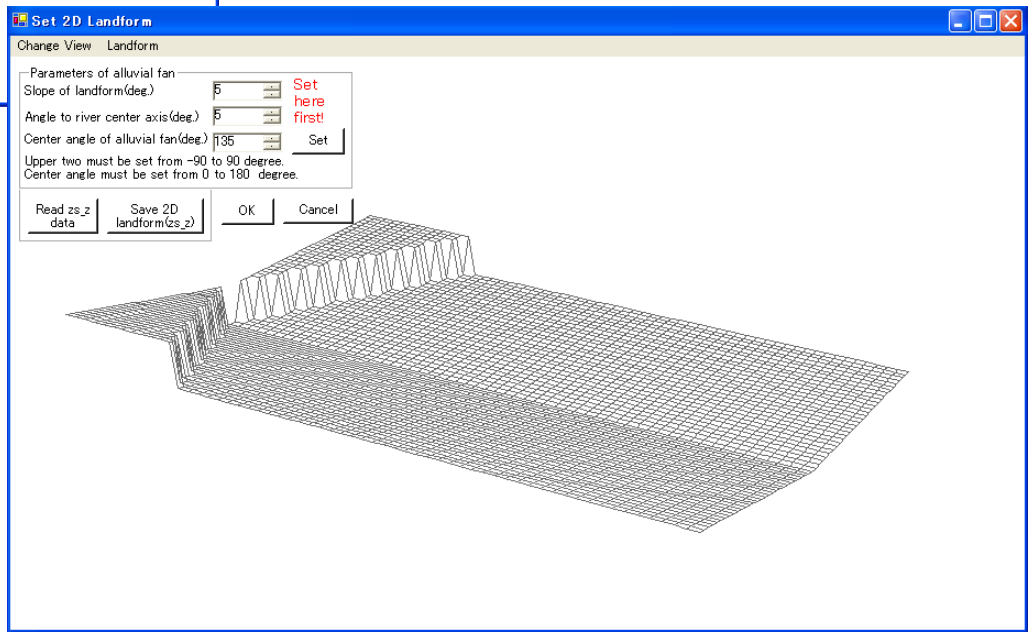




Change view(3-3)

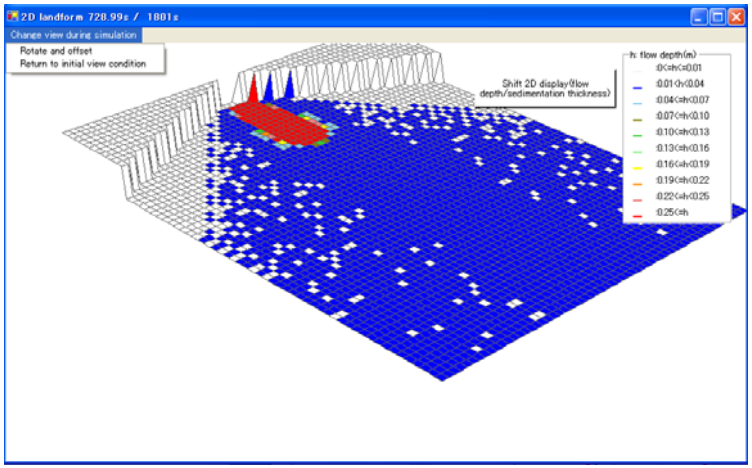
From Z-axis rotation:-25 deg, X-axis rotation ; 25 deg, and select “Return to initial condition”, display will be changed as the set initial condition view.

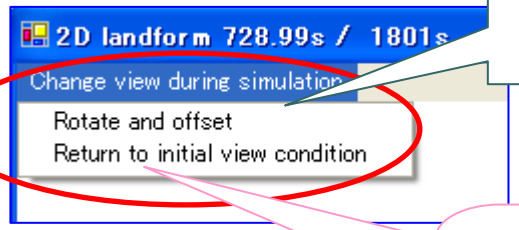




Change view during simulation

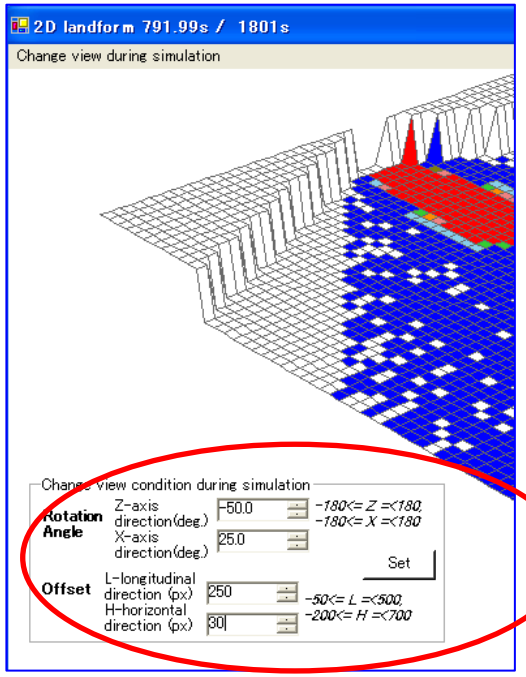
During simulation, you can change view in 2D landform.



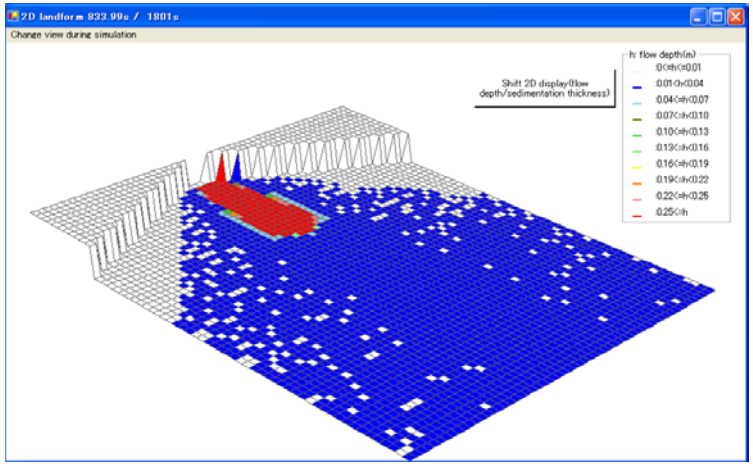


Select “Rotate and offset”

You can return to “initial condition” view.

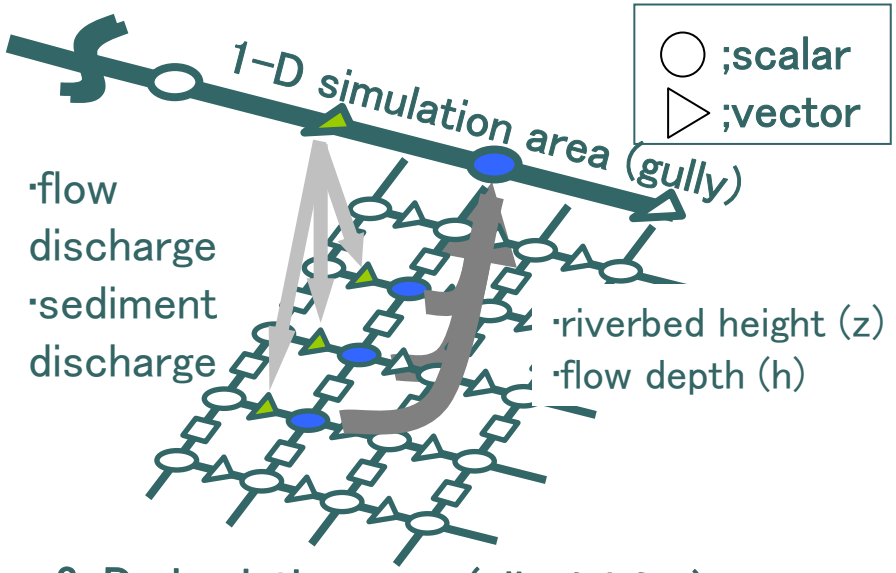


Same control as the 2-D landform input appears, and set view appropriate for the landform.



Appendix
Numerical Simulation Methods

The system is based on an integration model (*Wada et al :2008*).



Outline of Integration model

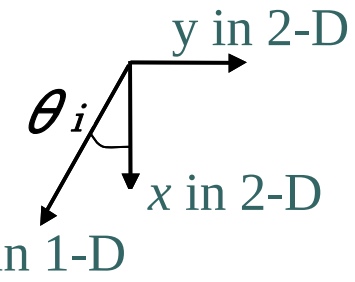
Integration model outline

gully areas	○1-dimensional simulations.
alluvial fans	○2-dimensional simulations.
boundary areas between gullies and alluvial fans	○considers their mutual influence.

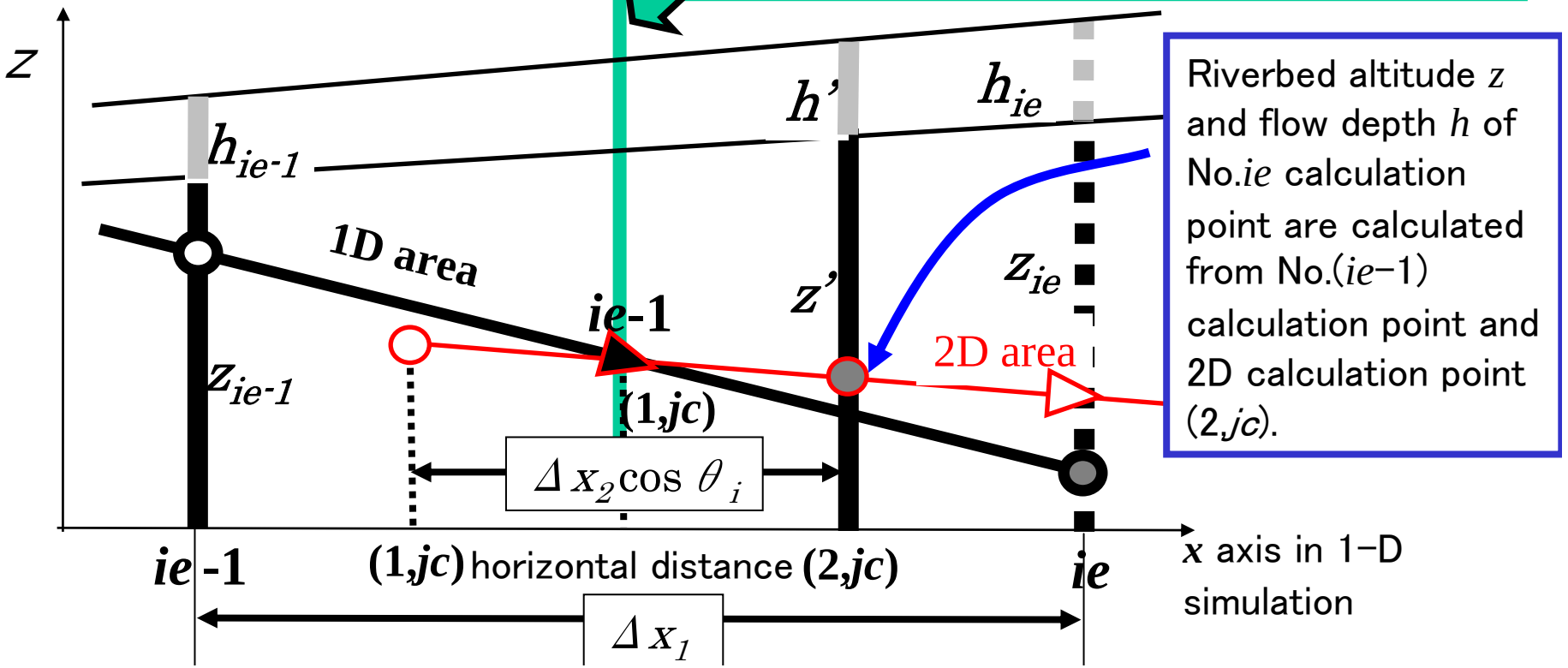
In case the interval of calculation points (Δx)are different between 1-D and 2-D area can be considered as the following figure.

z_i , h_i:1−D area No. i point's flow depth and riverbed elevation
z',h':2−D area upstream end's average flow depth and riverbed elevation
$(1, jc)$:inflow point in 2−D upstream end area's grid point coordinates
θ_i:angle between 1−D x−axis and 2−D x−axis
ie: 1−D downstream end calculation point number

Δx_1 : x direction grid interval in 1−D
Δx_2 :x direction grid interval in 2−D



Integration axis is inflow calculation point for inflow condition on boundary area.



Riverbed altitude z and flow depth h of No.ie calculation point are calculated from No.(ie−1) calculation point and 2D calculation point (2,jc).