Numerical simulation of Radionuclides Transport through Suspended Material into the Tokyo Bay.

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How much Radionuclides relased from Explosion of TEPCO Fukushima Daiichi Nuclear Power Plants

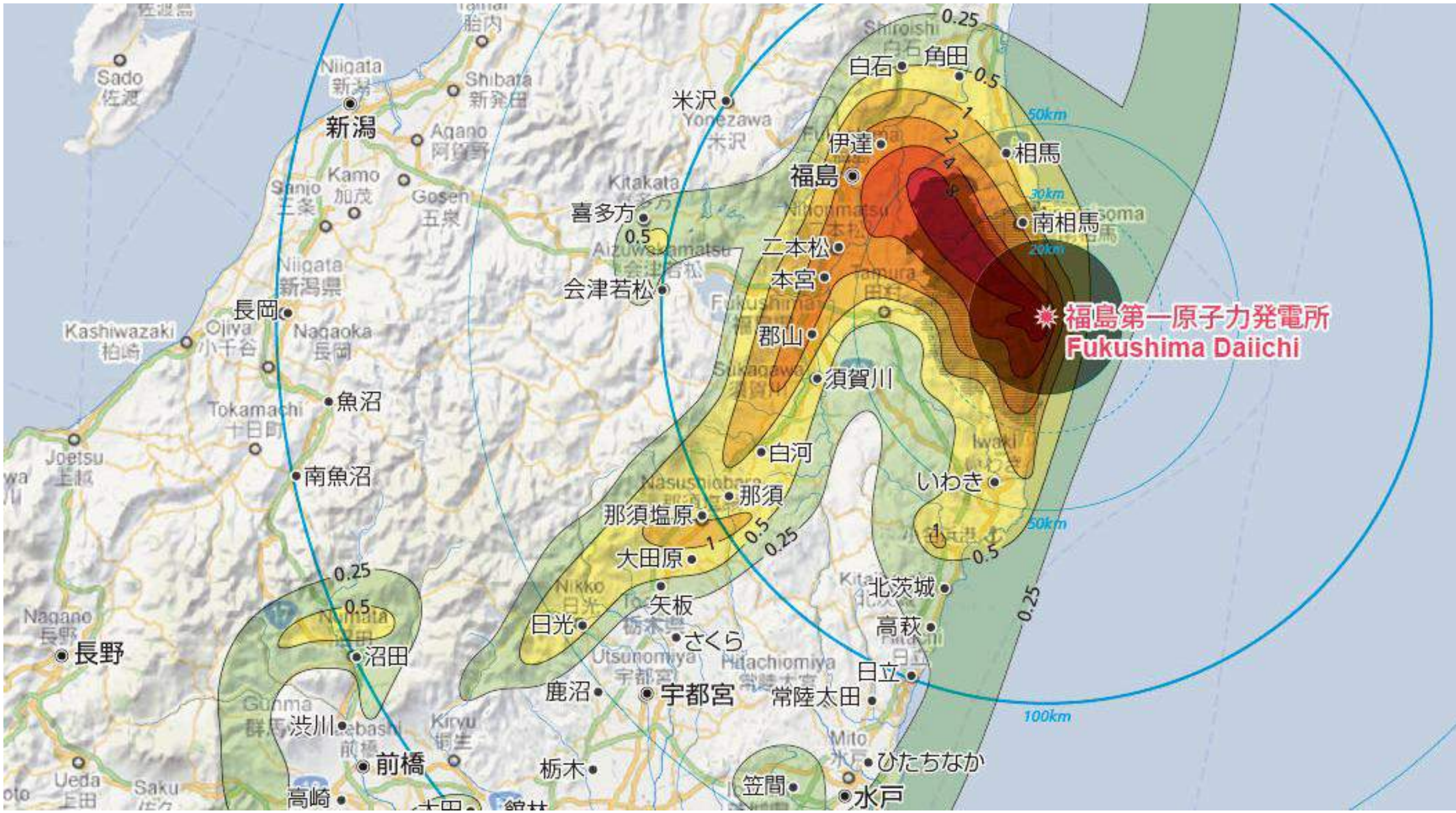
- 12 March 2011, Unit 1, Hydrogen Explosion Unit 1.
- 15 March 2011, Losing control in Operator
- 14 March 2011, Hydrogen (Nuclear) Explosion in Unit 3.
- 14 March 2011, Fire at the spent fuel pool in Unit 4.

How much Radionuclides in the Reactor (I-131, Cs-134, Cs-137)？

- I-131 4.68 E + 17 / 6.1 E + 18 … 7.6 %
- Cs-134 1.56 E + 17
- Cs-137 1.56 E + 17 / 7.1 E + 17 … 21.9 %
- Radioactive Iodine in the nuclear reactor 6.1 E + 18
- (Jap. Min. Edu)
- Total Radiocesium in the nuclear reactor 7.1 E + 17 (Jap. Min. Edu)
- Total Radionuclides equivalent to Iodine (Converted into I-131)

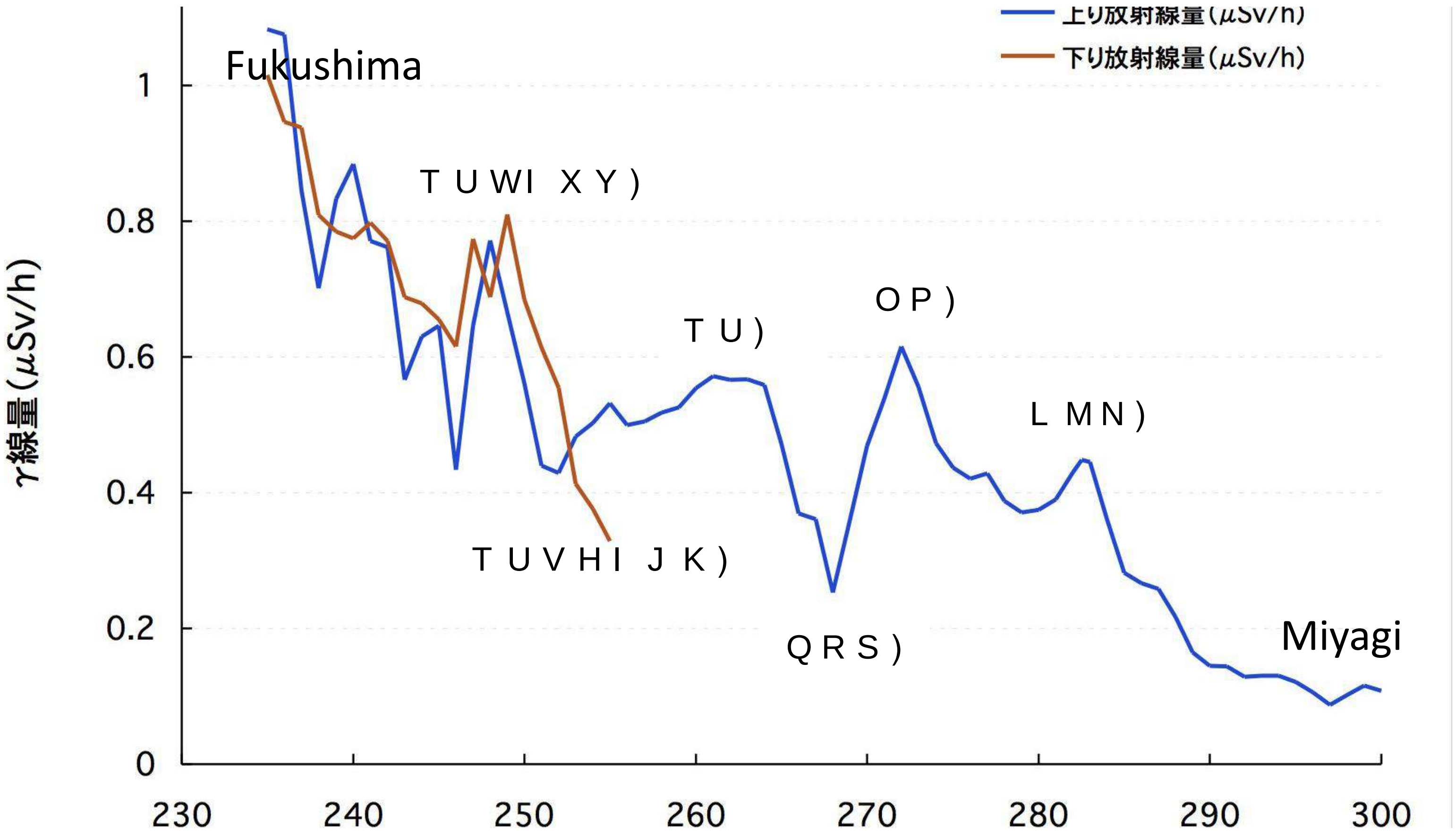
  = 770,000 Tela Bq ＝ 7.7 E + 17

A map of radiation dose by Dr. Hayakawa



Results of measurement by dose meter u Sv/h

Results of observation measured in the car



Hydrological Observation

Yosuke Yamashiki
Taeko Wakahara
Yuichi Onda
Yasuhito Igarashi
Yasuto Tachikawa
Michiharu Shiiba

Hydrological Observation Sensor

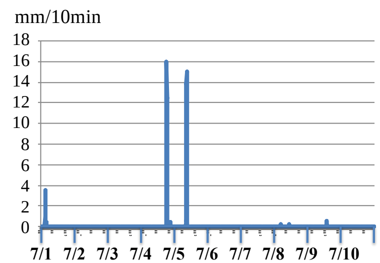
- Water pressure sensor
- Suspended material capture
- Turbidity sensor
- Data loggar
- Rain guage

Structure for the measuring

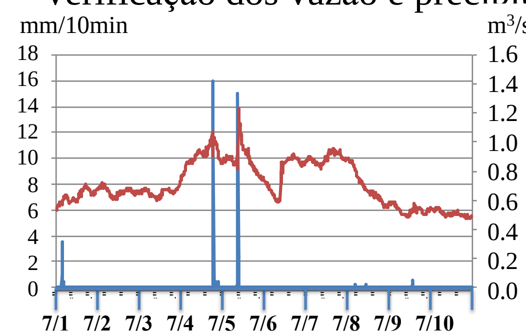
- Modelo hidrologico

Pruviometrico

Precipitação



Verificação dos vazão e precipitação

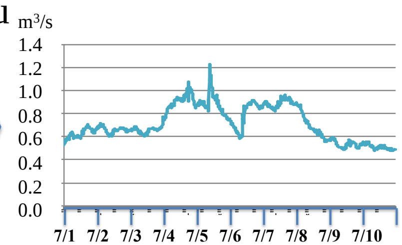


Dado de medidor de pressão

Estimativa da vazão

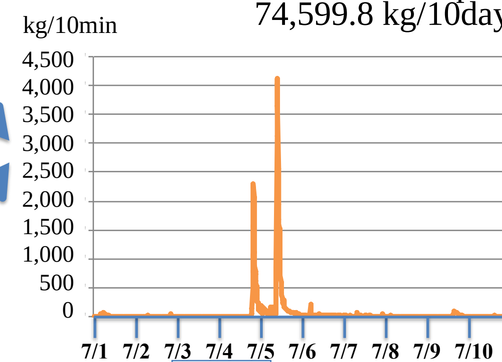
Curva Chave 82,936,847.9 kg/10days

Calculo de Nivel' d'agu



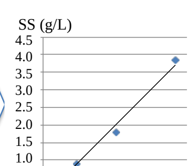
Calculo de Flux de material suspendido

74,599.8 kg/10days

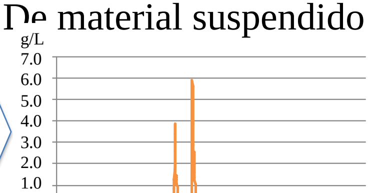


Sensor de turbides

Curva de calibração

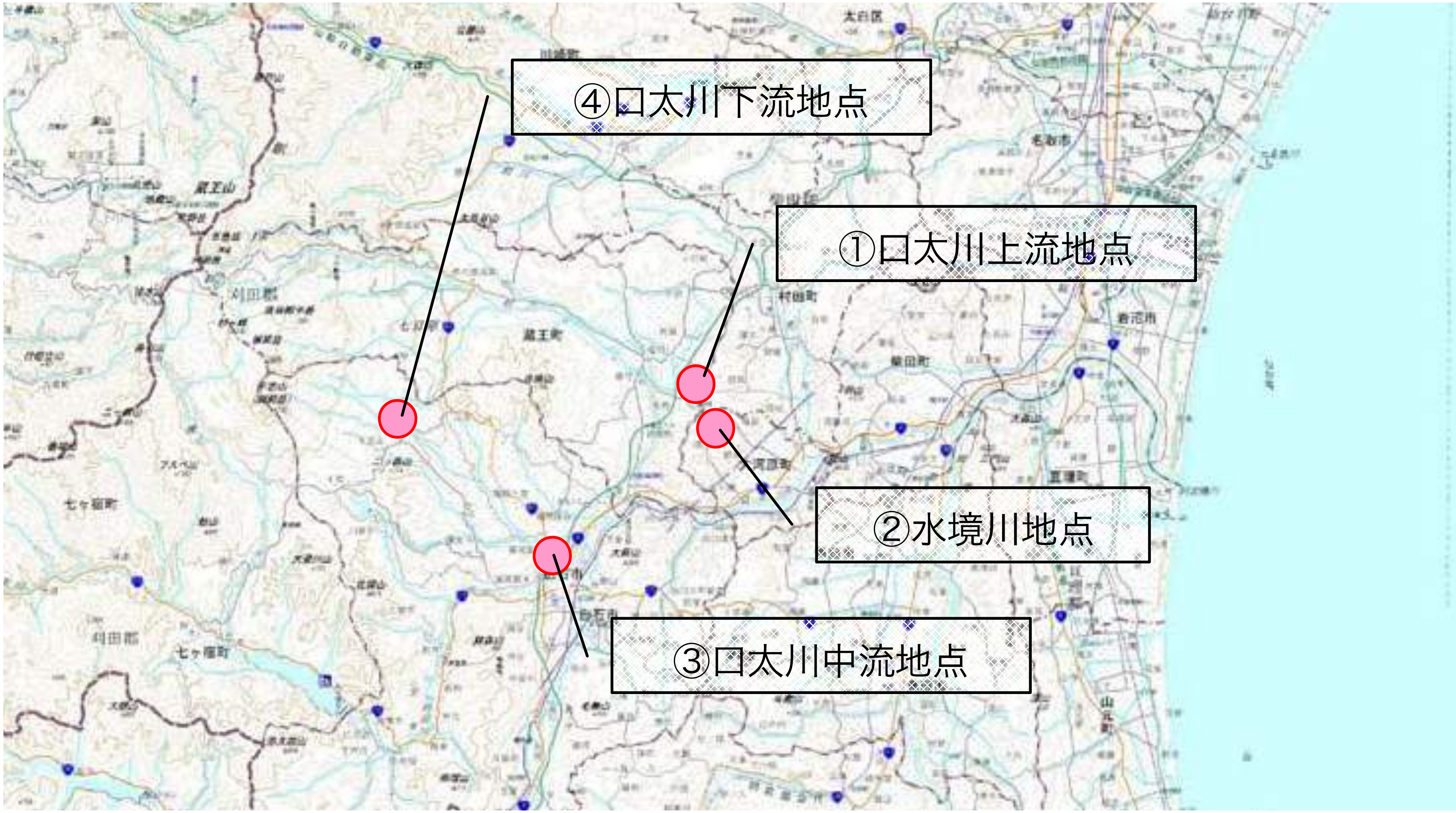


Calculo de concentração
De material suspendido



Monitoring points

Monitoring points



Monitoring point No1

Monitoring Point No1

Monitoring Point No1

Monitoring Point No1


販売中止中です
店主
WONDA

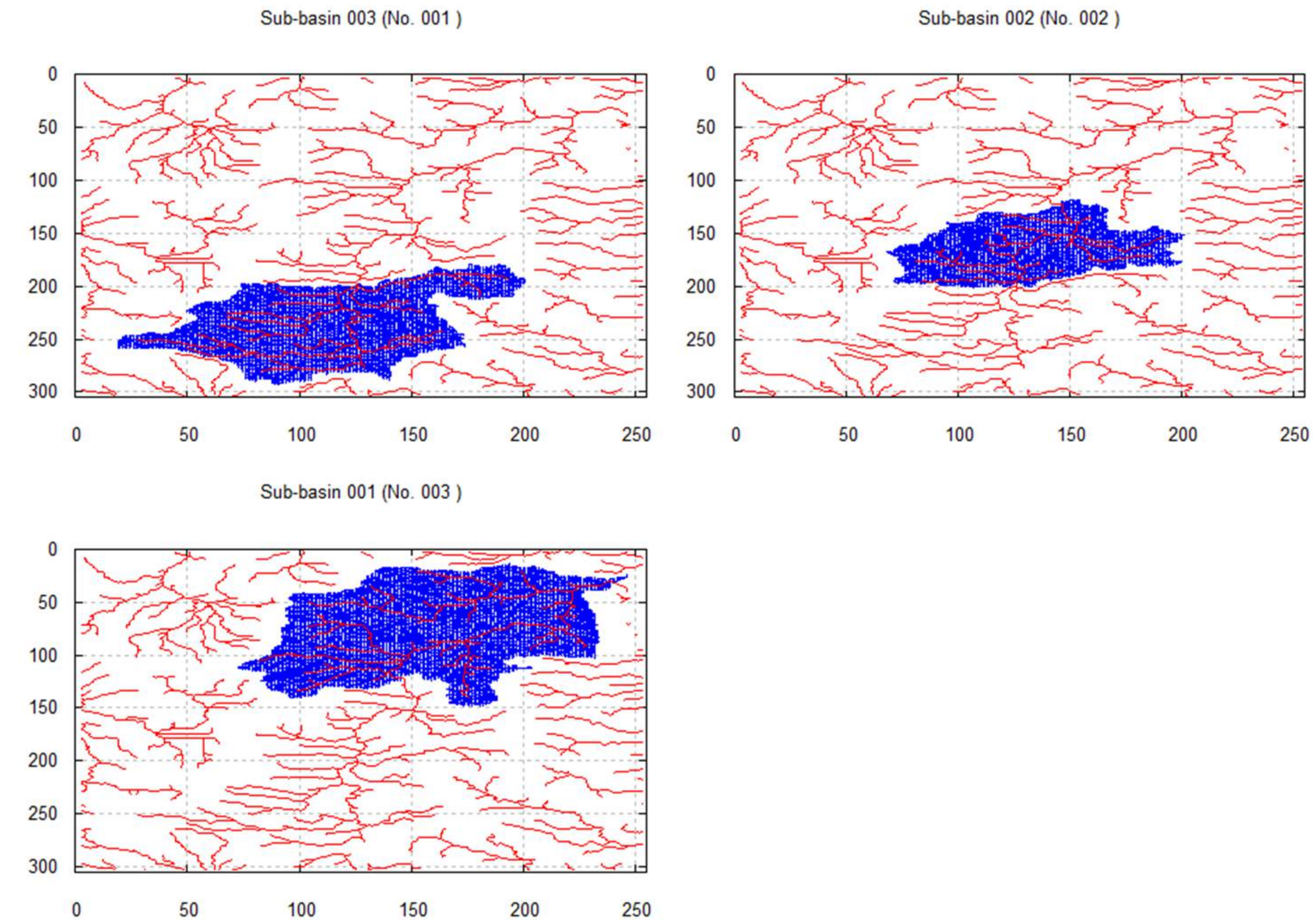
Daily radionuclide fluxes

	Averaged DAILY SS FLUX			
	137Cs		134Cs	
	FLUX(Bq)	誤差Bq	FLUX(Bq)	誤差Bq
01水境川	1.40E+08	8.61E+06	1.22E+08	7.89E+06
02口太川上流	1.49E+08	4.13E+06	1.34E+08	4.45E+06
03口太川中流	4.34E+08	2.89E+07	3.51E+08	2.48E+07
04口太川下流	2.56E+09	6.68E+07	2.17E+09	5.98E+07
上記4地点の平均期間	(2011/ 6/ 21/ 12:00- 2011/ 8/ 30/ 12:00)			
05伏黒	8.88E+10	3.69E+09	8.21E+10	2.35E+09
伏黒の平均期間	(2011/ 8/ 10/ 12:00- 2011/ 8/ 30/ 12:00)			
06岩沼	2.81E+10	1.44E+09	2.28E+10	1.29E+09
岩沼の平均期間	(2011/ 8/ 10/ 12:00- 2011/ 8/ 30/ 12:00)			

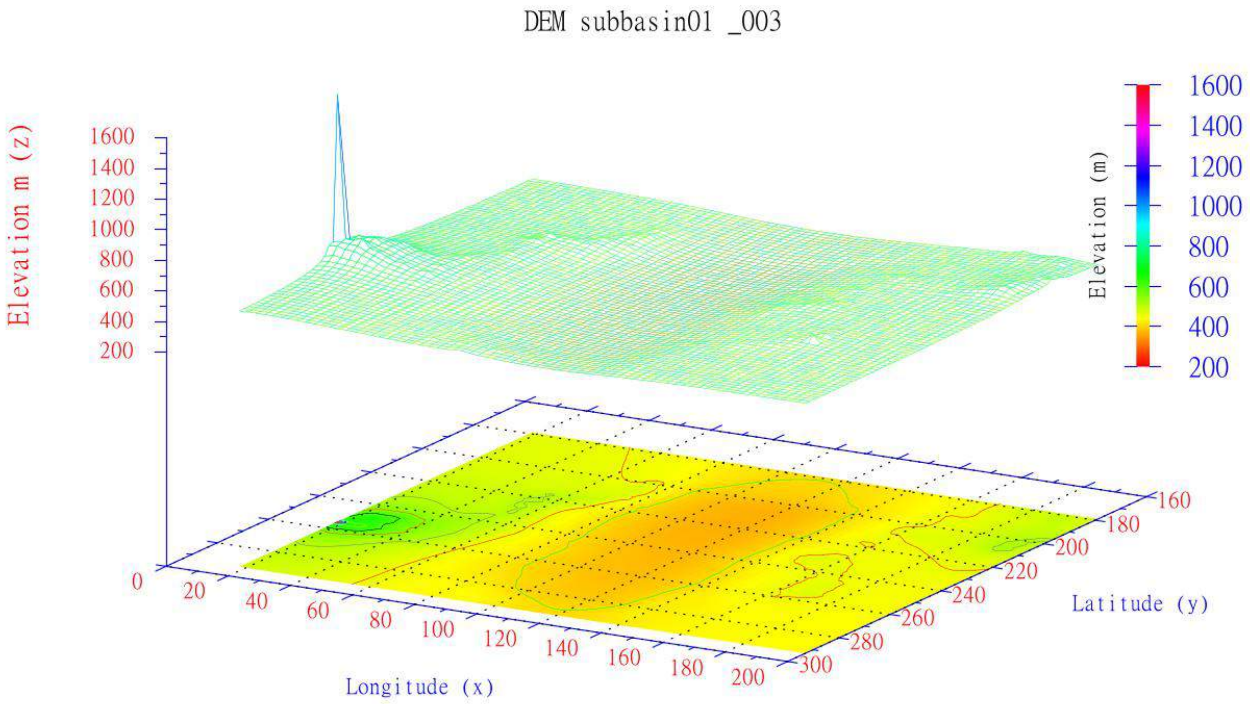
Suspended particulate matter transport

Contribution of Suspended

Location	Period	Cs-134 (%)	Cs-137 (%)
Sakai □	2011/6/21 12:00 - 2011/8/30 12:00	96.9	96.6
Upstream Kuchibuto□	2011/6/21 12:00 - 2011/8/30 12:00	94.6	93.8
Middle Kuchibuto□	2011/6/21 12:00 - 2011/8/30 12:00	92.7	92.4
Outlet Kuchibuto□	2011/6/21 12:00 - 2011/8/30 12:00	97.8	97.6
Middle Abukuma□	2011/8/1012:00 - 2011/8/30 12:00	94.6	95.6
Outlet Abukuma□	2011/8/10 12:00 - 2011/8/30 12:00	68.9	75.7

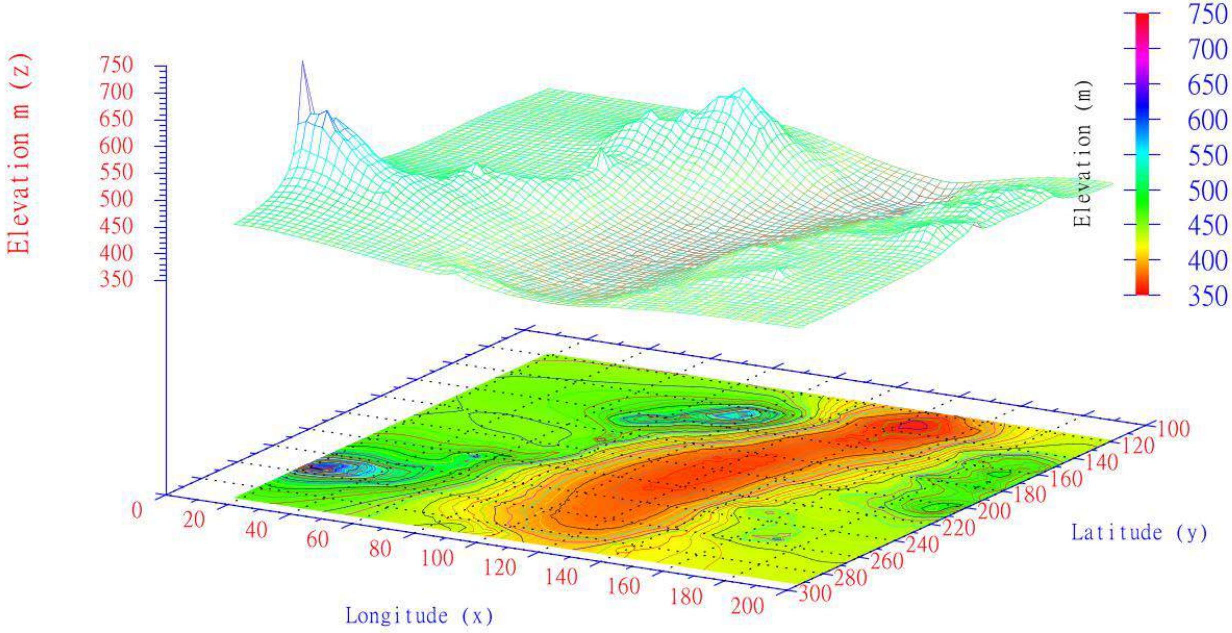


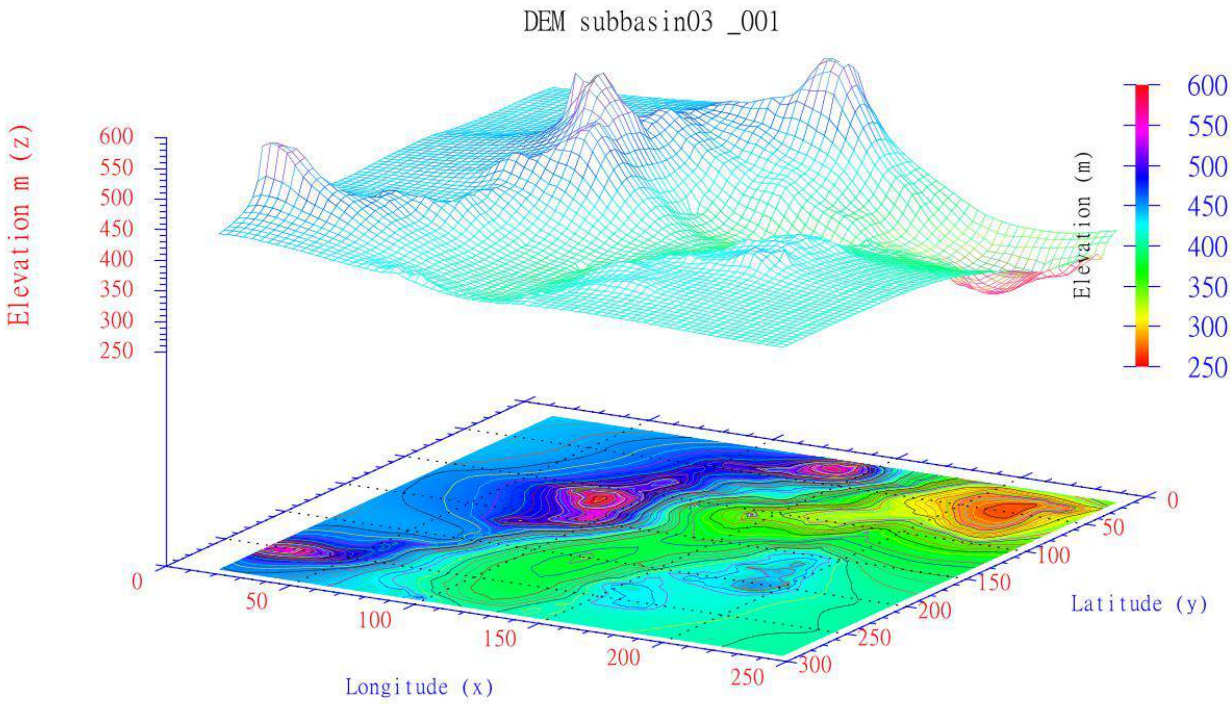
-25.1567, -520.294

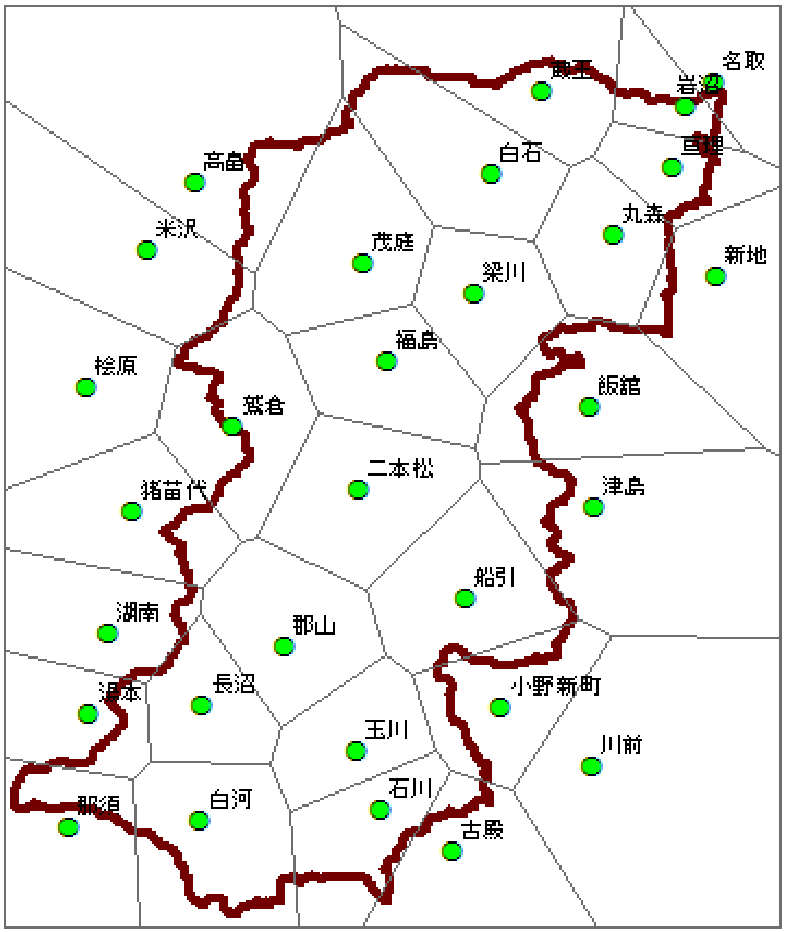


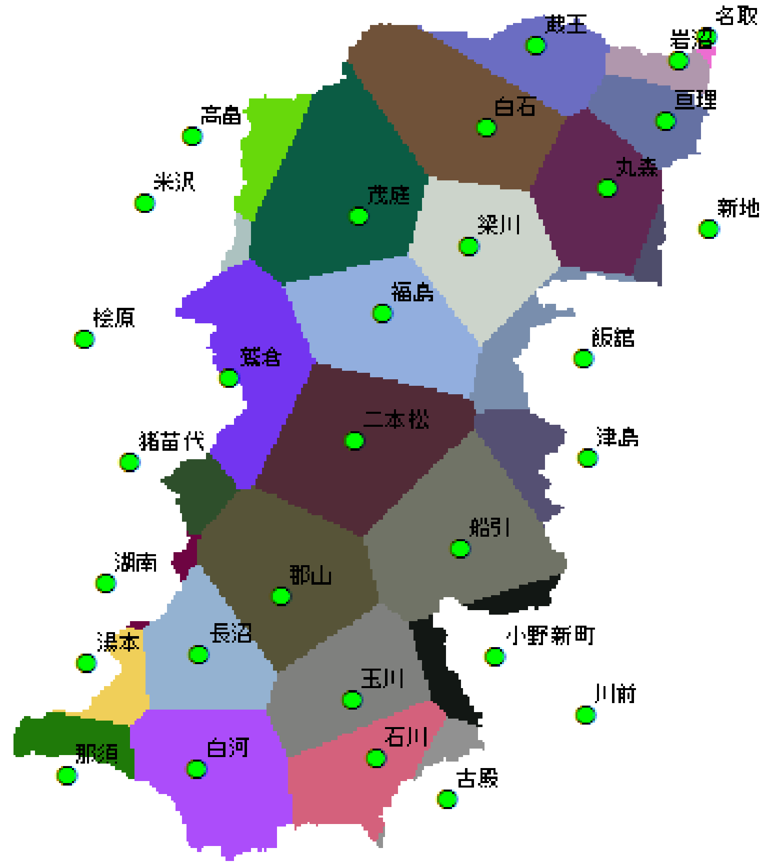
DEM subbasin01 _003
Elevation m (z)
1600
1400
1200
1000
800
600
400
200
0
20
40
60
80
100
120
140
160
180
200
Longitude (x)
160
180
200
220
240
260
280
300
Latitude (y)
Elevation (m)
1600
1400
1200
1000
800
600
400
200

DEM subbasin02 _002




DEM subbasin03 _001
Elevation m (z)
600
550
500
450
400
350
300
250
0
Elevation (m)
600
550
500
450
400
350
300
250
Longitude (x)
50
100
150
200
250
Latitude (y)
0
50
100
150
200
250
300


蔵王
名取
岩沼
白石
亘理
高畠
丸森
米沢
茂庭
新地
梁川
福島
桧原
飯舘
鷲倉
二本松
猪苗代
津島
船引
湖南
郡山
湯本
長沼
小野新町
玉川
川前
白河
石川
那須
古殿


名取
蔵王
岩沼
白石
亘理
高畠
丸森
米沢
茂庭
新地
梁川
福島
桧原
飯舘
鷲倉
二本松
津島
猪苗代
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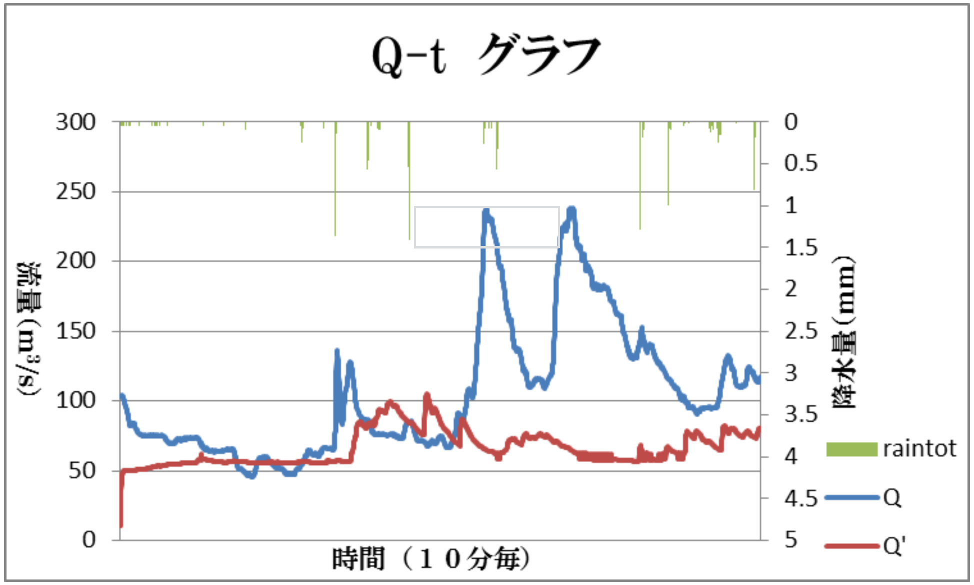
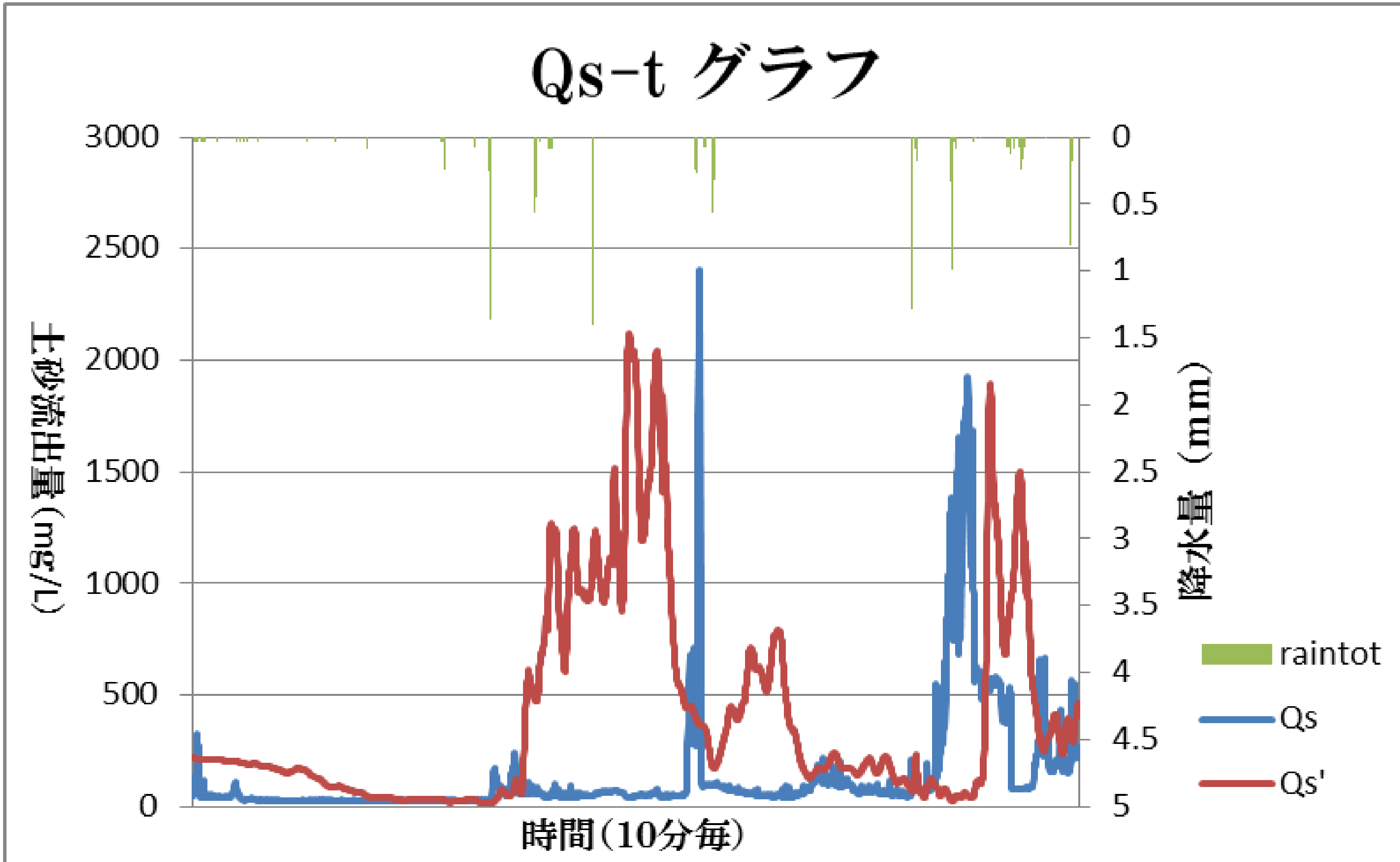
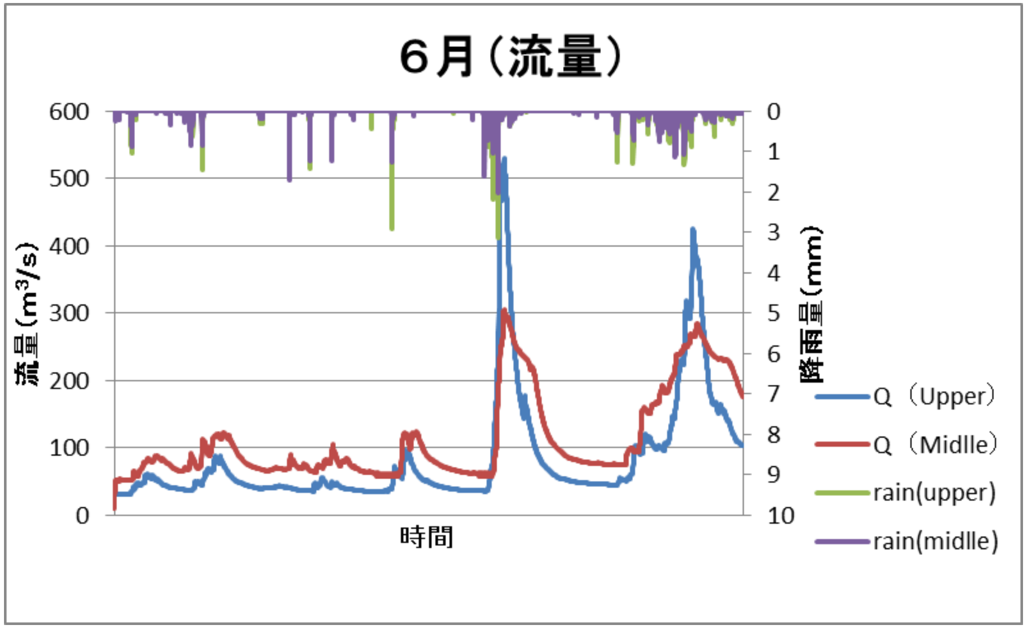
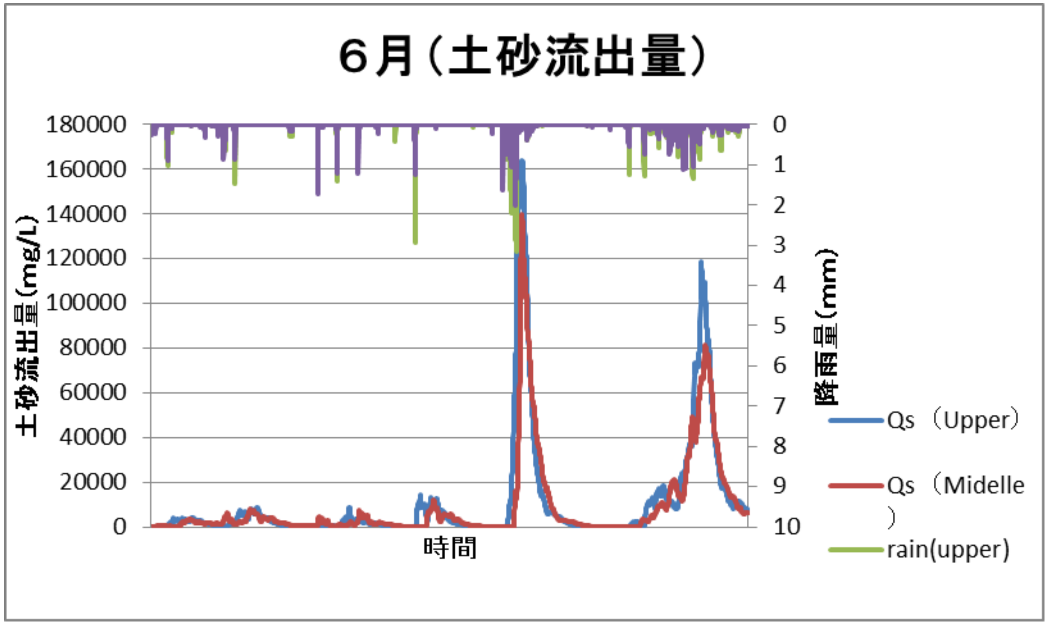
湖南
郡山
小野新町
湯本
長沼
玉川
川前
石川
那須
白河
古殿


Q-t グラフ
300
250
200
150
100
50
0
流量(m³/s)
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
降水量(mm)
時間（１０分毎）
raintot
Q
Q'


Qs-t グラフ
3000
2500
2000
1500
1000
500
0
土砂流出量（mg/L）
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
降水量（mm）
時間（10分毎）
raintot
Qs
Qs'



６月（流量）
流量（m3/s）
600
500
400
300
200
100
0
降雨量（mm）
0
1
2
3
4
5
6
7
8
9
10
時間
Q（Upper）
Q（Midlle）
rain(upper)
rain(midlle)


6月（土砂流出量）
土砂流出量(mg/L)
180000
160000
140000
120000
100000
80000
60000
40000
20000
0
降雨量(mm)
0
1
2
3
4
5
6
7
8
9
10
時間
Qs（Upper）
Qs（Midelle
）
rain(upper)

Lagrangian Hydrological Model

- Most of Radiocesium may transported via suspended particulate form, not via dissolved form.
- Suspended particulate matter should keep their properties through their transport into downstream.

Decay Coefficients

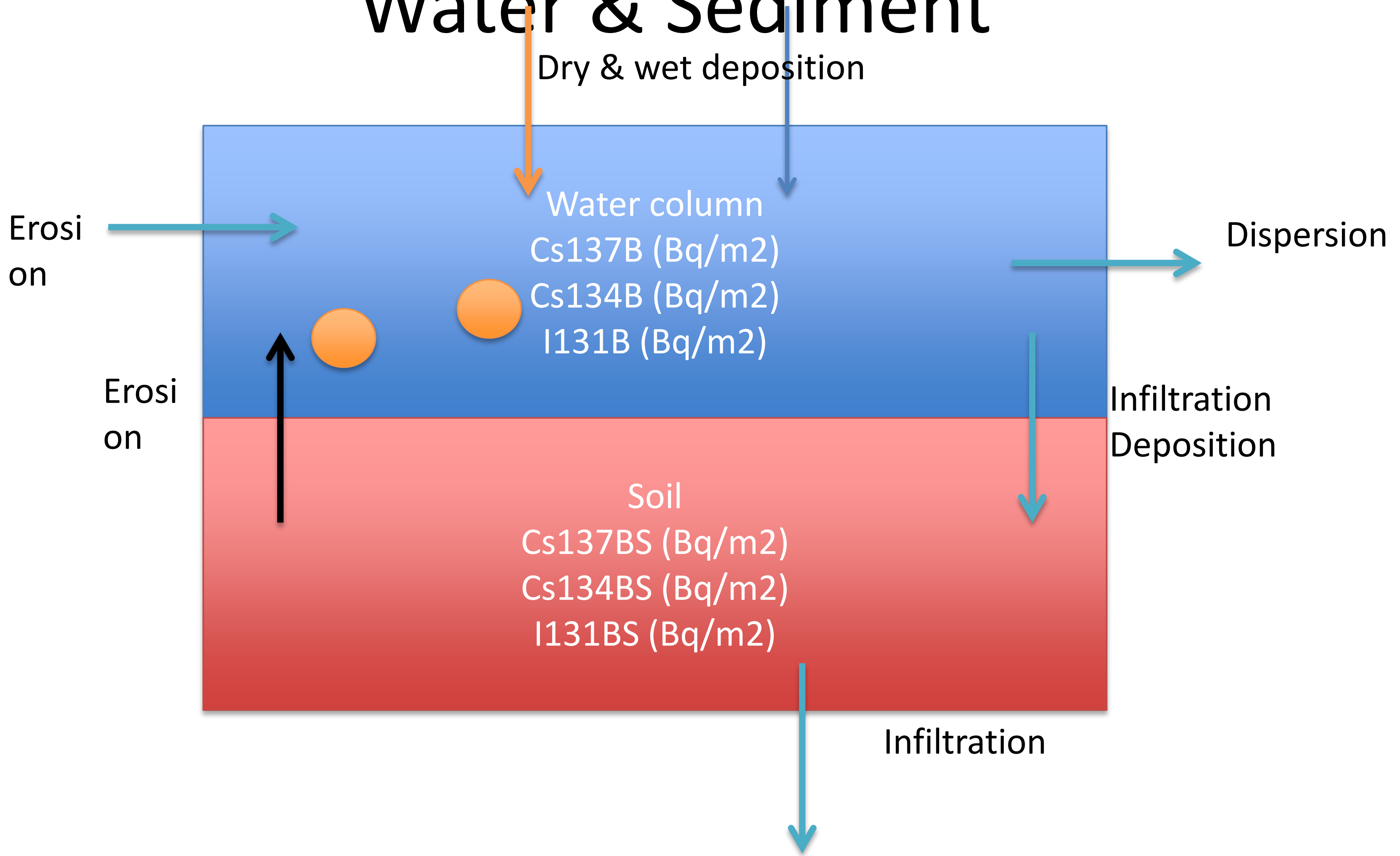
$$CI131_{T=T+DT} = CI131_{T} \exp\left(- /_{I131} DT\right)$$

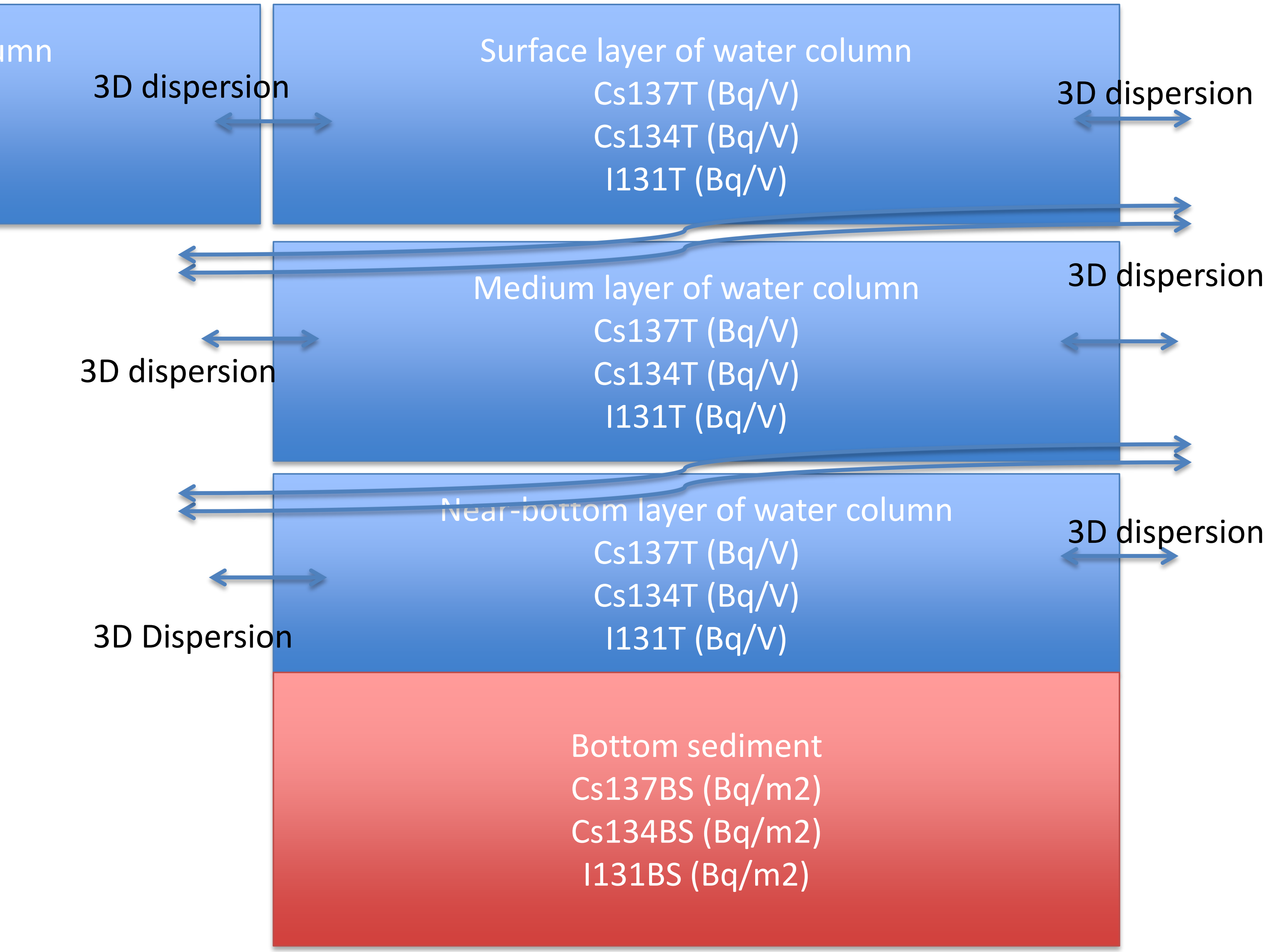
$$/_{Cs137} = 0.0000633$$

$$/_{Cs134} = 0.000921$$

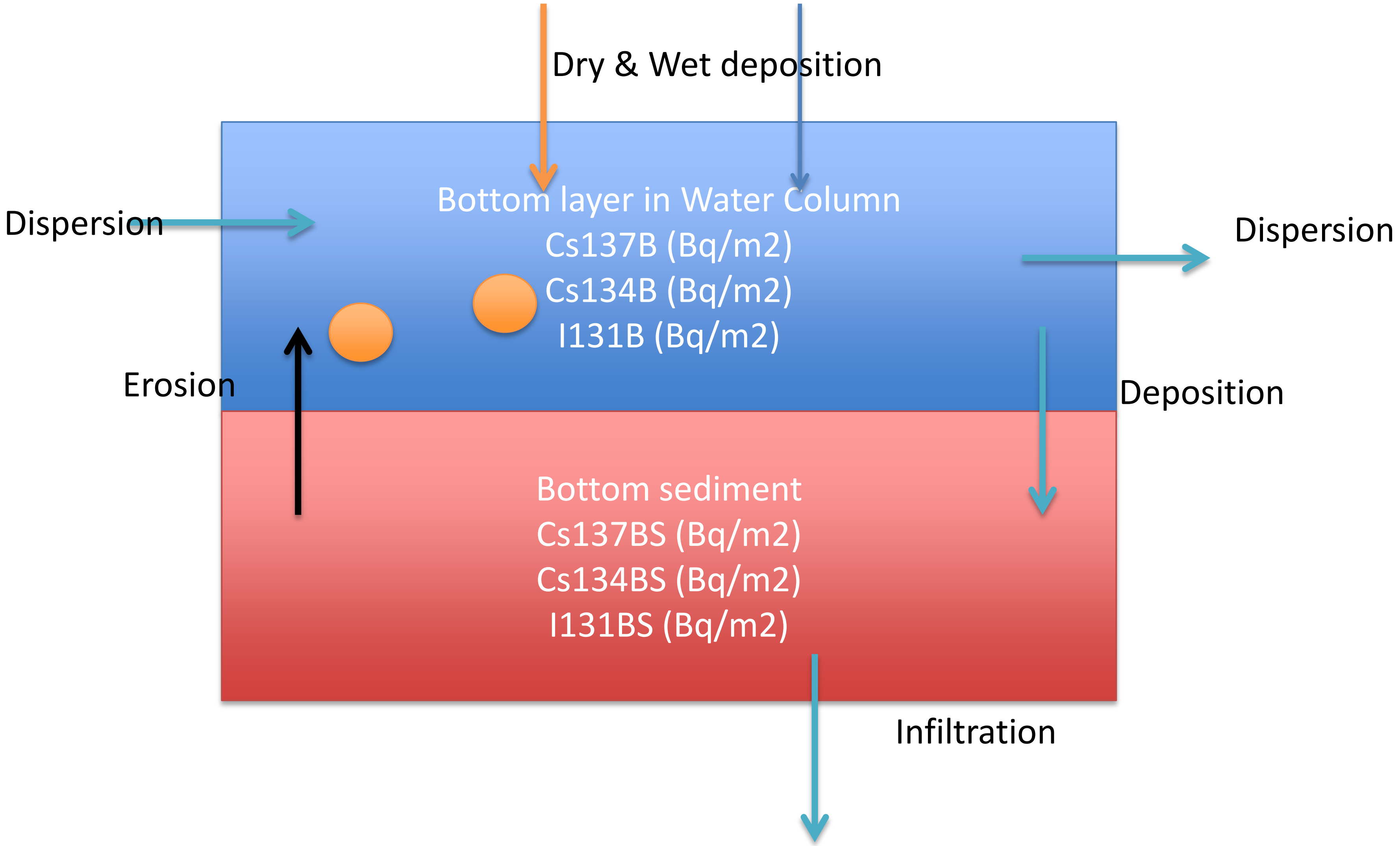
$$/_{I131} = 0.08621(/day)$$

Balance of radionuclides in Water & Sediment

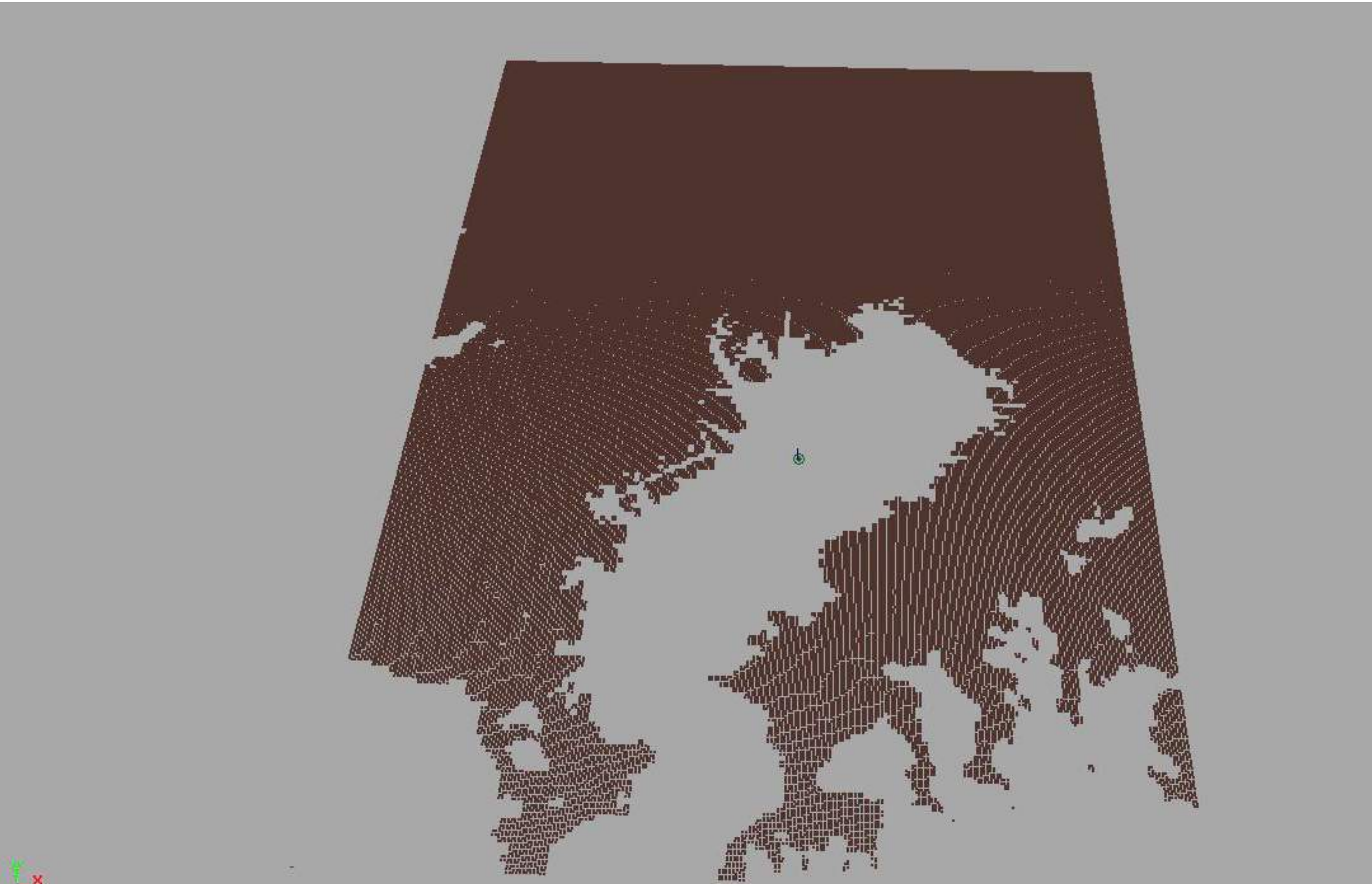


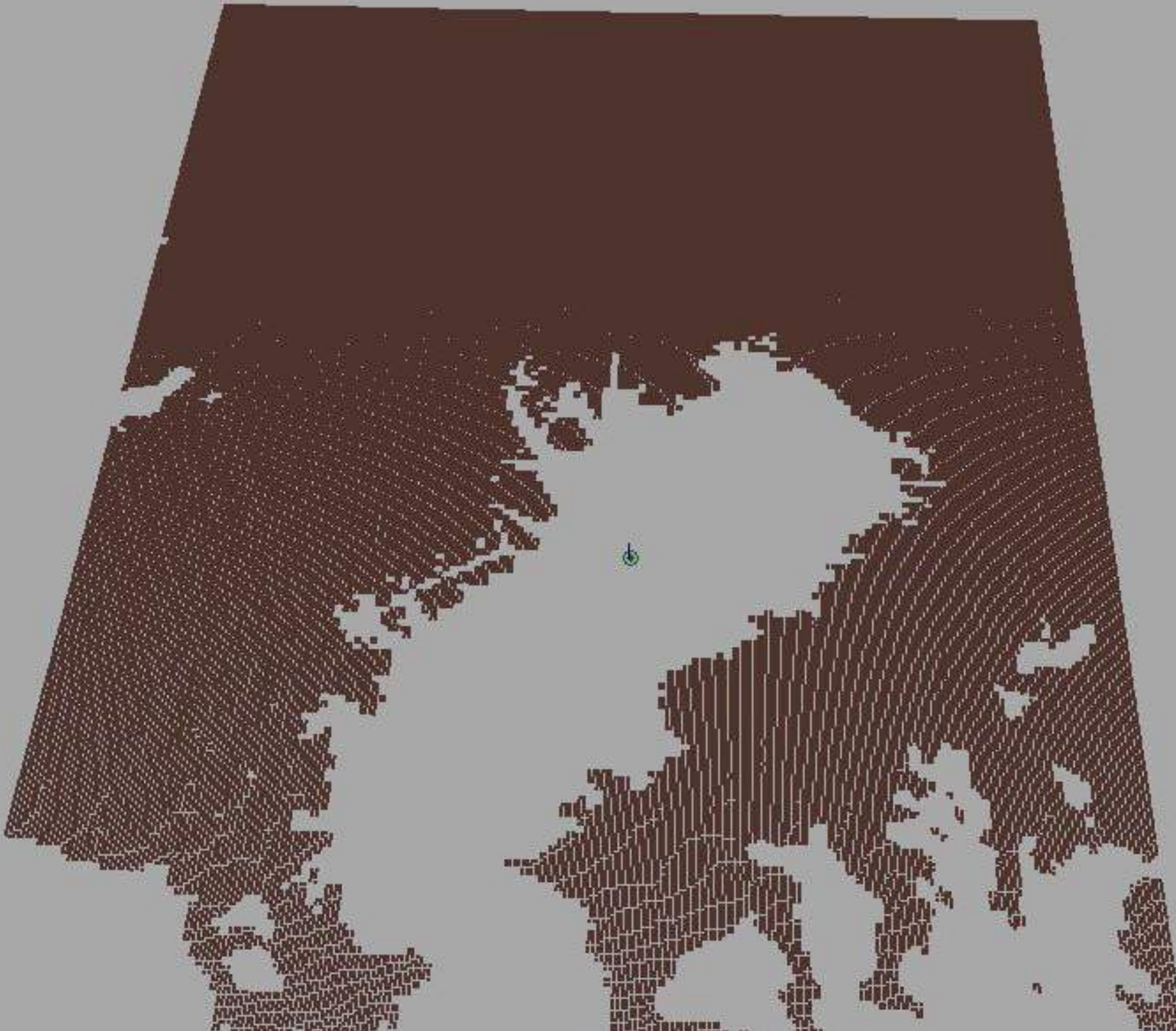

umn
3D dispersion
Surface layer of water column
Cs137T (Bq/V)
Cs134T (Bq/V)
I131T (Bq/V)
3D dispersion
Medium layer of water column
Cs137T (Bq/V)
Cs134T (Bq/V)
I131T (Bq/V)
3D dispersion
3D dispersion
Near-bottom layer of water column
Cs137T (Bq/V)
Cs134T (Bq/V)
I131T (Bq/V)
3D dispersion
3D Dispersion
Bottom sediment
Cs137BS (Bq/m2)
Cs134BS (Bq/m2)
I131BS (Bq/m2)

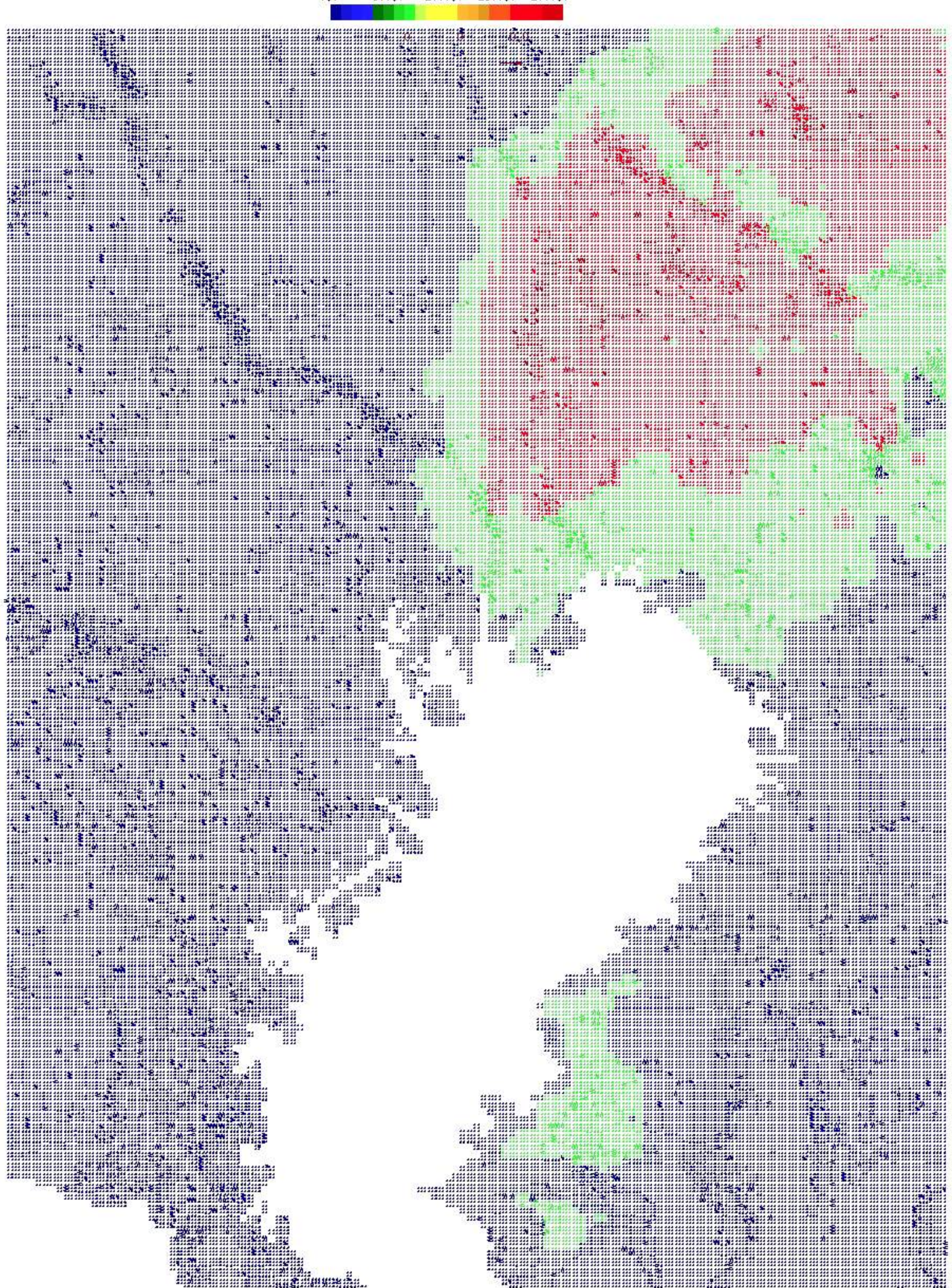
Bottom sediment

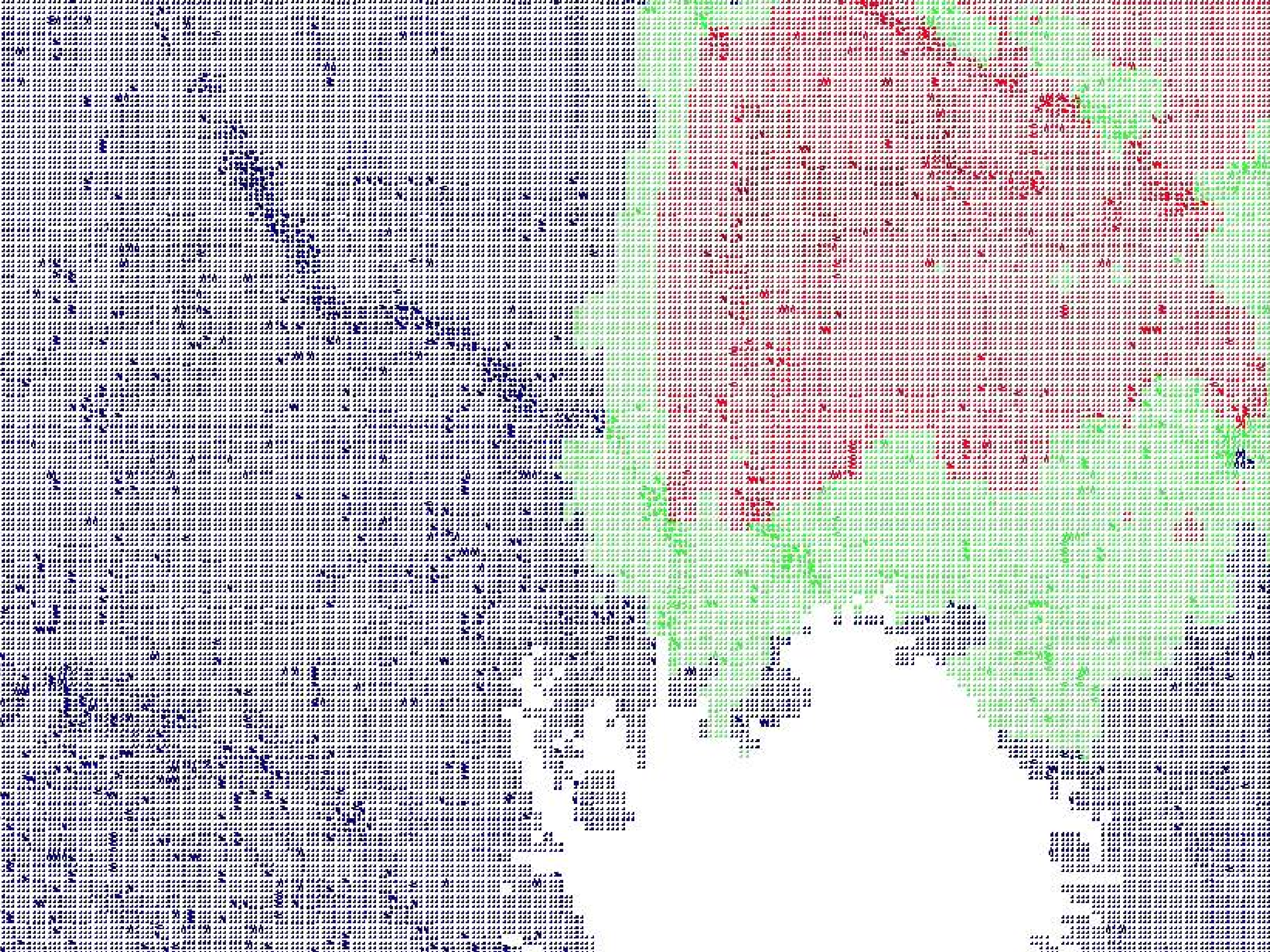


Lagrangian Hydrological Model Tokyo Bay

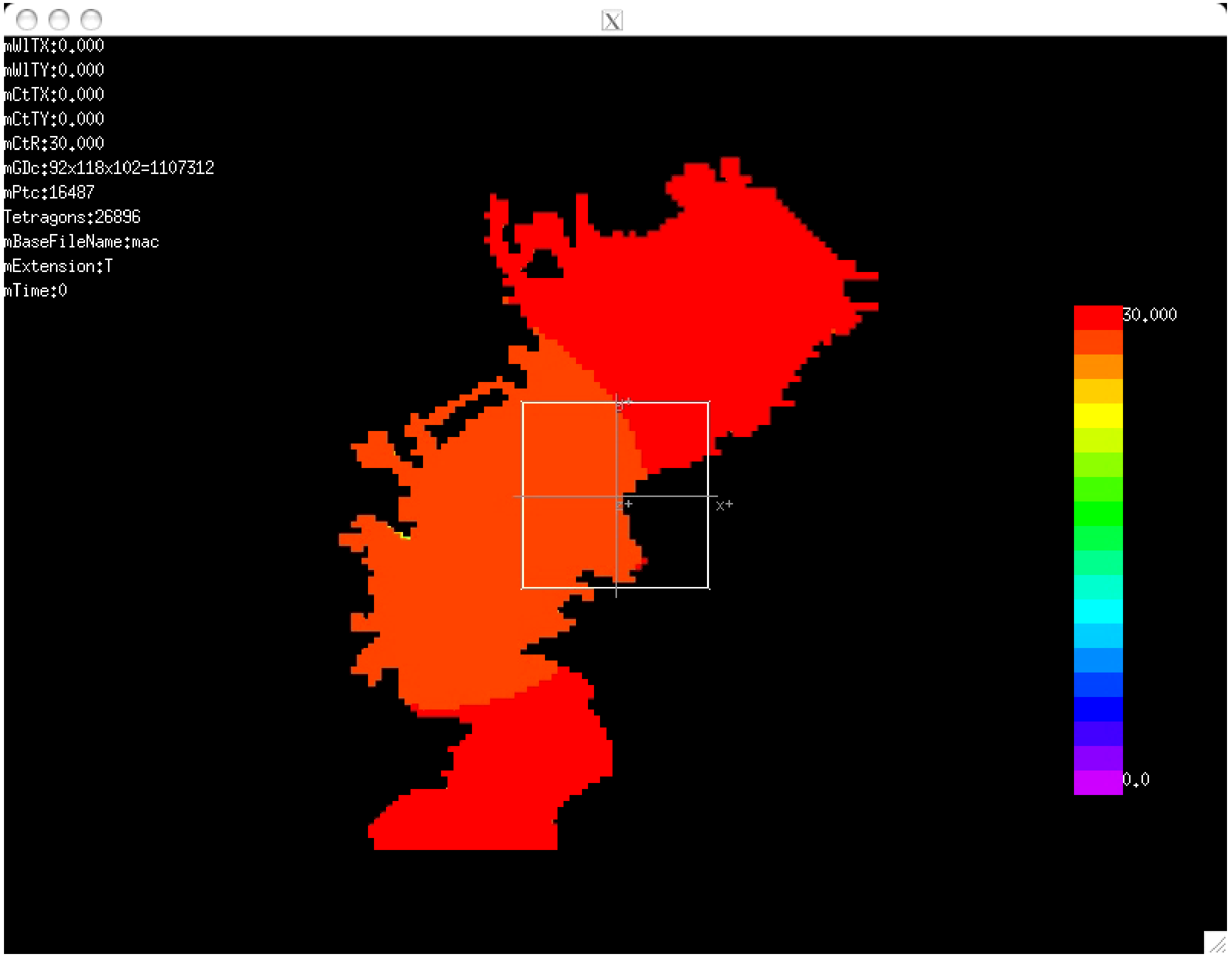




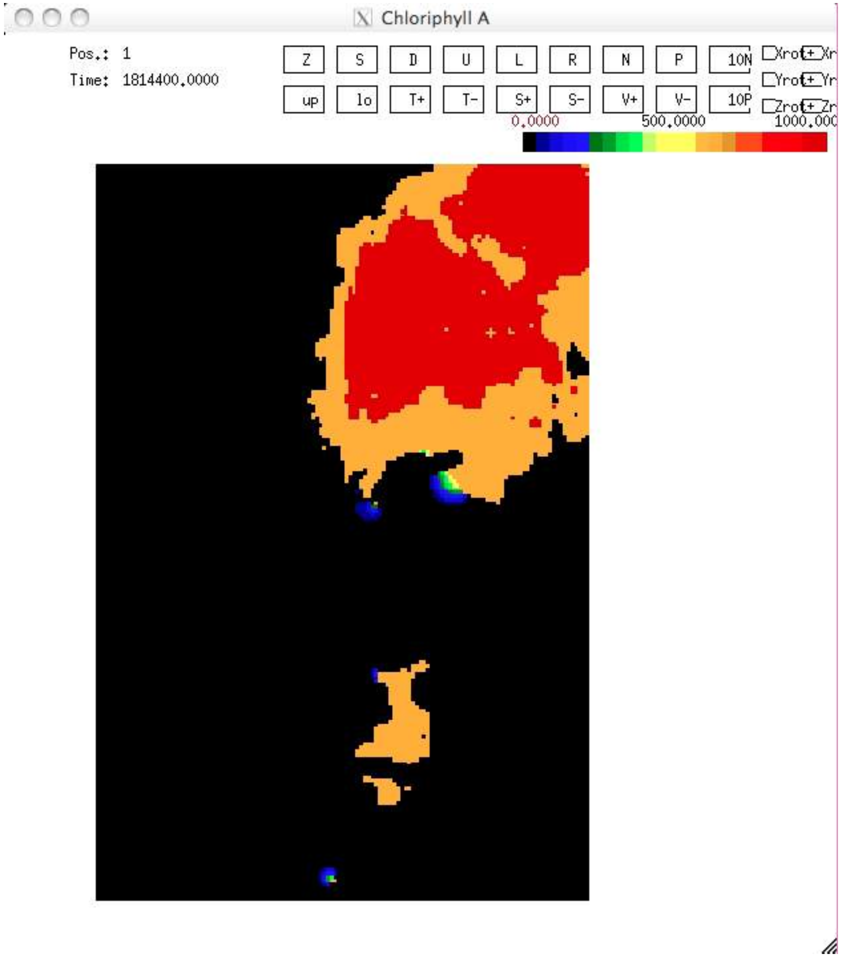




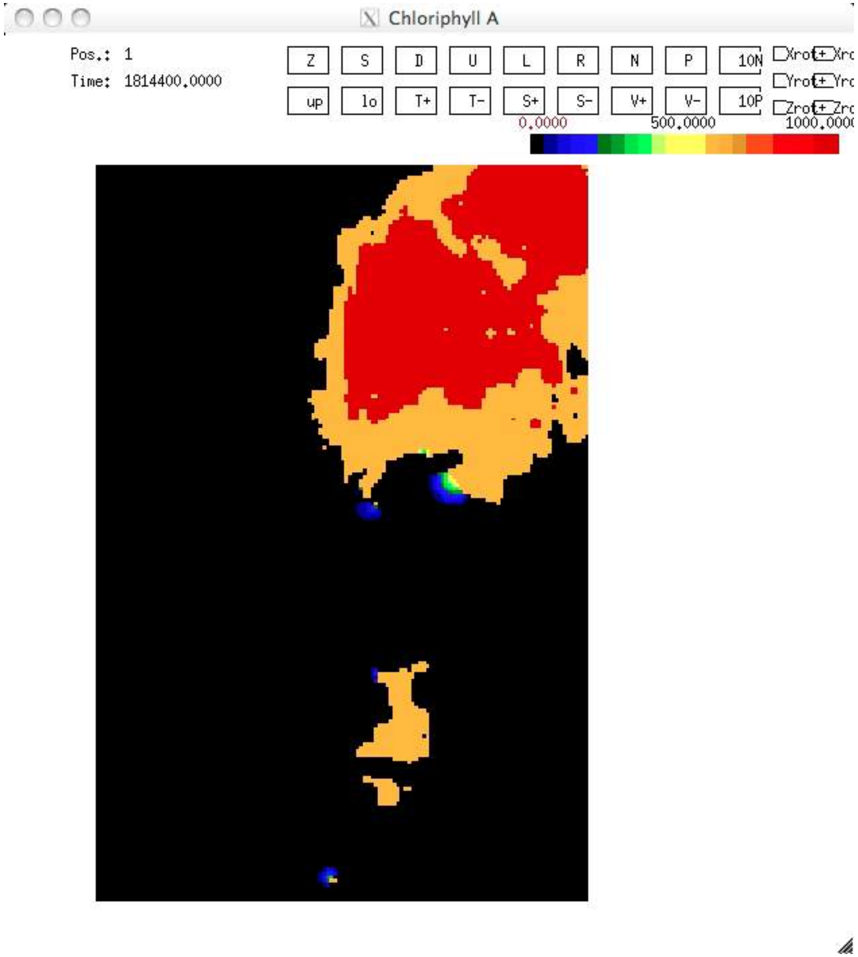
3D Estuary Model
Tokyo3D



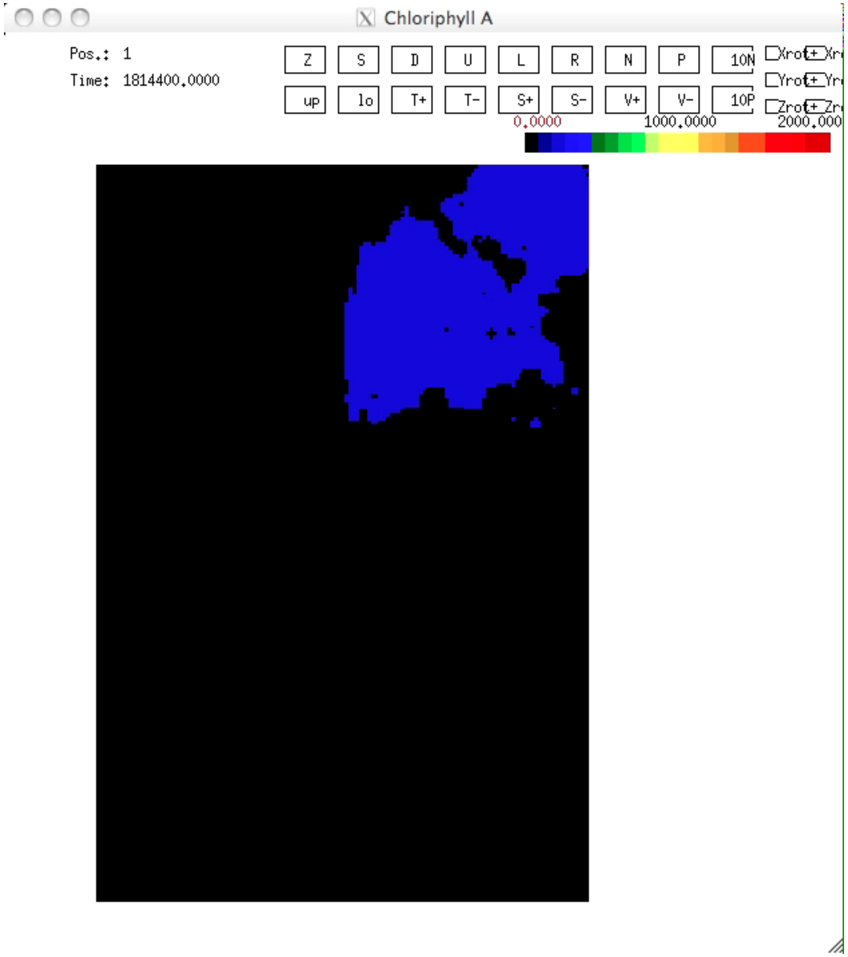
Cs137 Dispersion in Tokyo Bay



Cs134 Dispersion in Tokyo Bay



I131 Dispersion in Tokyo Bay



NHK Television Movie

Observation results

Conclusion

- Radioactive sediment (containing radionuclides released from the Fukushima nuclear power plant) in Tokyo Bay may increase within three years of its release due to an increase of hydrological transport (mainly induced by the Cs137/134), and may last for more than 10 years (mainly by Cs137).
- The model also predicted bottom-sediment contamination near the Obitsu River outlet, as well as in some hotspots at outlets of the Edo and Ara rivers.

Conclusion

- However, so far serious contamination in fishes and shellfishes
- Sediment treatment should be examined into contaminated bottom sediment to avoid further dispersion in the Bay