

Introduction of flood evacuation route search using QGIS, PostGIS, GRASS and pgRouting



FOSS4G 2010

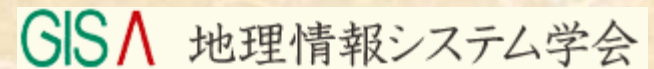
Barcelona

Monday 6th through Thursday 9 September, 2010

Yoichi Kayama

Self-introduction

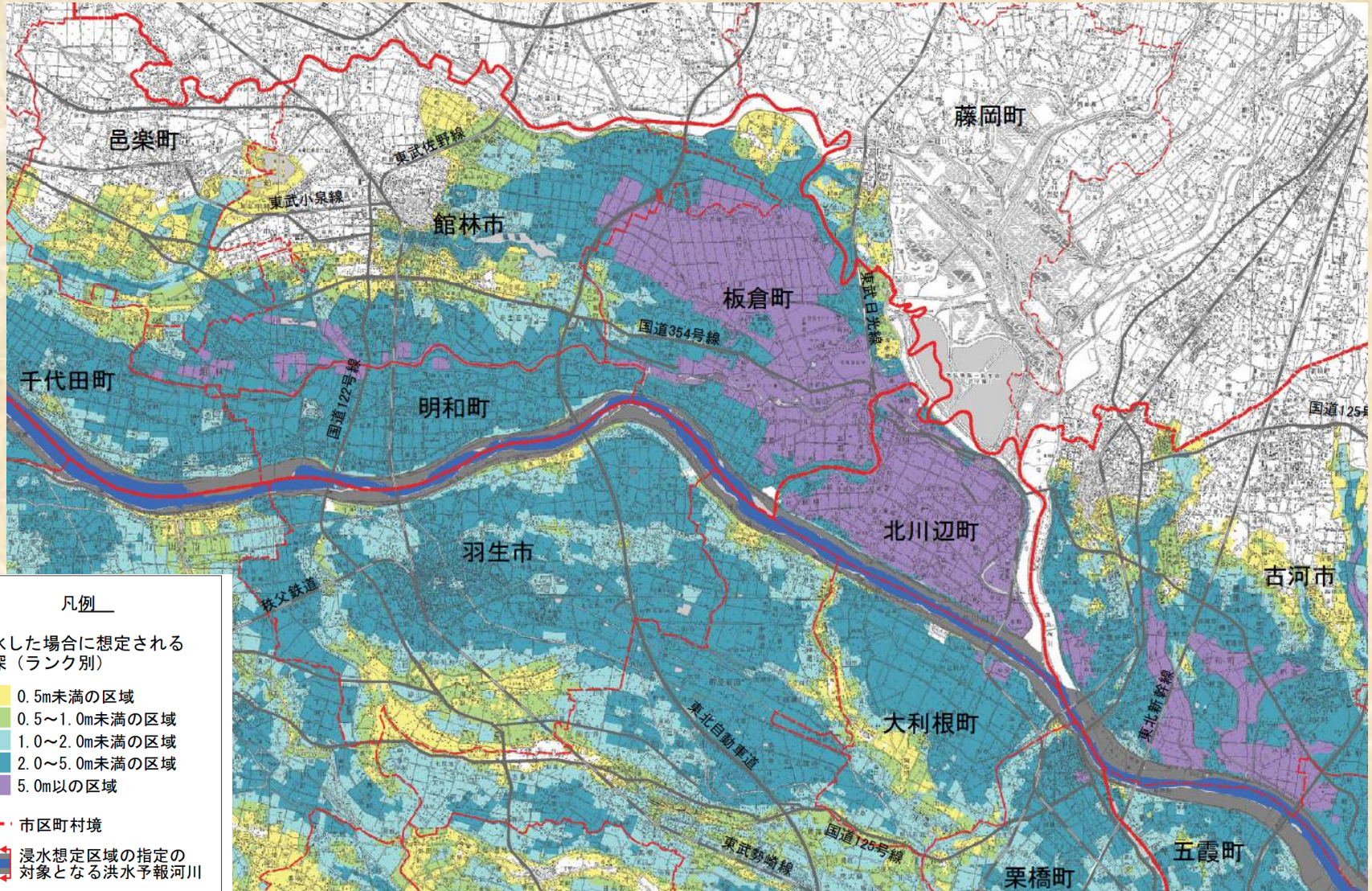
- A member of OSGeo.JP
- A member of GISA Japan(also a member of FOSS4G SIG)
- Coordinator of QGIS Japanese GUI translators
- Working as GIS programmer and researcher at Aero Asahi Corporation



Flood area simulation map

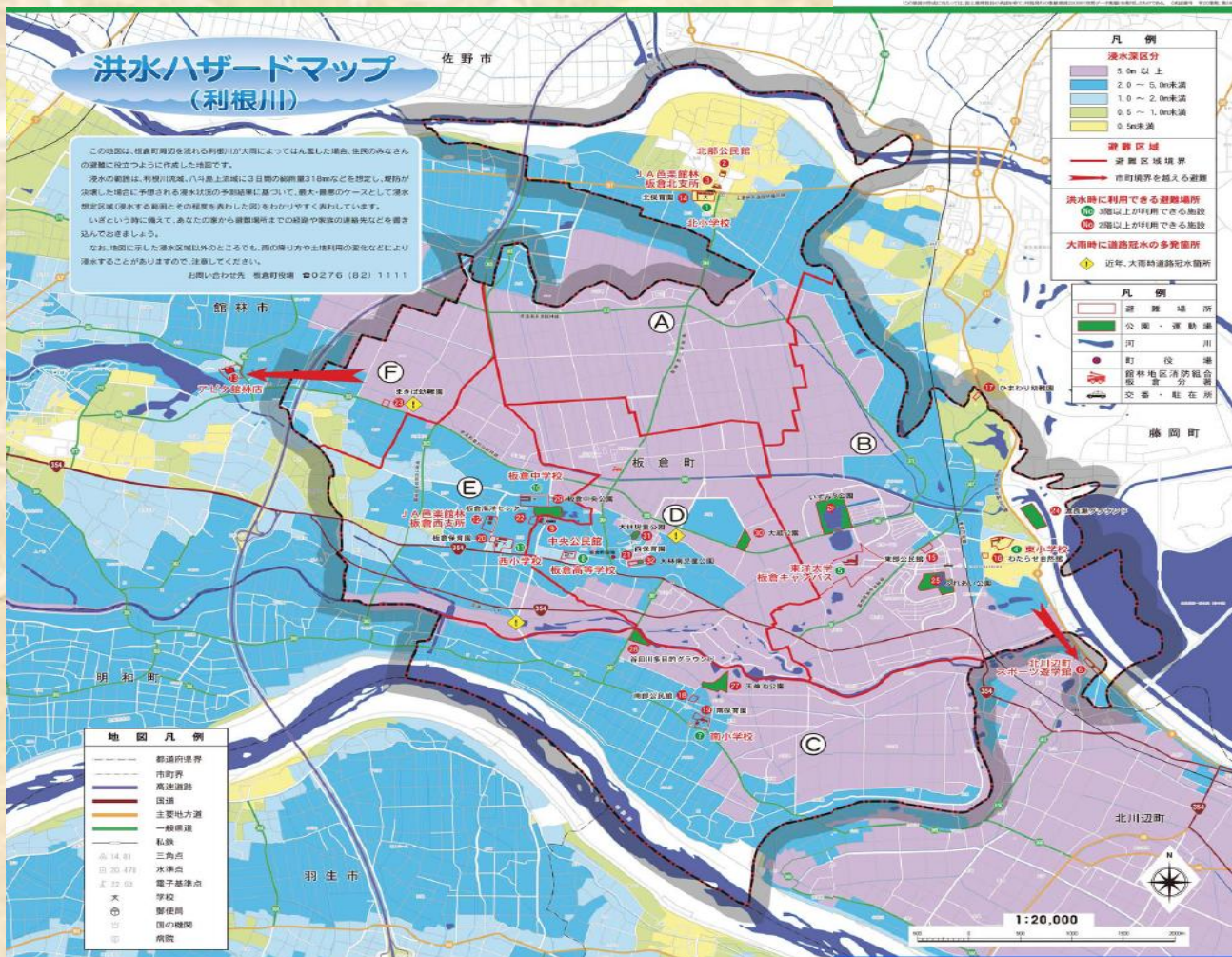
- In Japan, since 2001 , MLIT(The Ministry of Land, Infrastructure, Transport and Tourism) and prefectural governments made maps of flood area simulation about major rivers.

Flood area simulation map



http://www.ktr.mlit.go.jp/tonejo/saigai/sinsuisoutei/tonegawa_zentai.pdf

Hazard map (made by local government)



避難場所一覧						
	施設名	住所	電話番号	避難人数(人)	備考	
災害時 避難場所 の 一 覧	1池上小学校	池上3955	77-9099	1, 2, 3,		
	2法蓮小学校	西谷485-2	77-1005	4, 5, 6		
	3J丸森商業 総合公民館	西谷17	77-9045	7, 8, 9,		
	4東谷小学校	東谷4822	82-1441	10, 11, 12,		
	5東谷中学校	東谷4821	82-3911	13, 14, 15, 16,		
	6池上1地区スポーツセンター	池上1600-1-1	0309-61-2299	30, 31, 32		
	7池上町	大岡町1595	82-1143	1, 11, 13, 17, 19		
	8東谷中学校	東谷4821	82-1258	19, 20, 21,		
	9中谷公民館	東谷2635	82-2435	22, 23,		
	10東谷中学校	東谷2770	82-1143	23, 24,		
	11中谷中学校	東谷2771	82-1140	25, 26,		
	12池上中学校	池上1503	82-1253	28		
	13アリスホテル	池上1600-1-1	75-3411	29		
	14東谷中学校	東谷1331	77-9045	—	F	
	15東谷中学校	東谷1705-1	82-1241	—		
	16わたなべ音楽館	東谷4840-1	82-1935	—		
	17（仮称）市民会館	東谷1744	82-1339	—		
	18池上中学校	東谷1744-1	82-1424	—		
	19東谷中学校	大岡町1595	—	—		
	20中谷中学校	池上001	03-1147	—		
	21東谷中学校	東谷1589	—	—		
	22東谷中学校	東谷1592	82-0858	—		
	23中谷中学校	東谷1334	82-1582	—		
	24東谷中学校	東谷1589	—	—		
	25大岡町	東谷2742-43	—	—		
	26大岡町	大岡16	—	—		
	27大岡町	東谷2415-4	—	—		
	28大岡町	東谷2338-3	—	—		

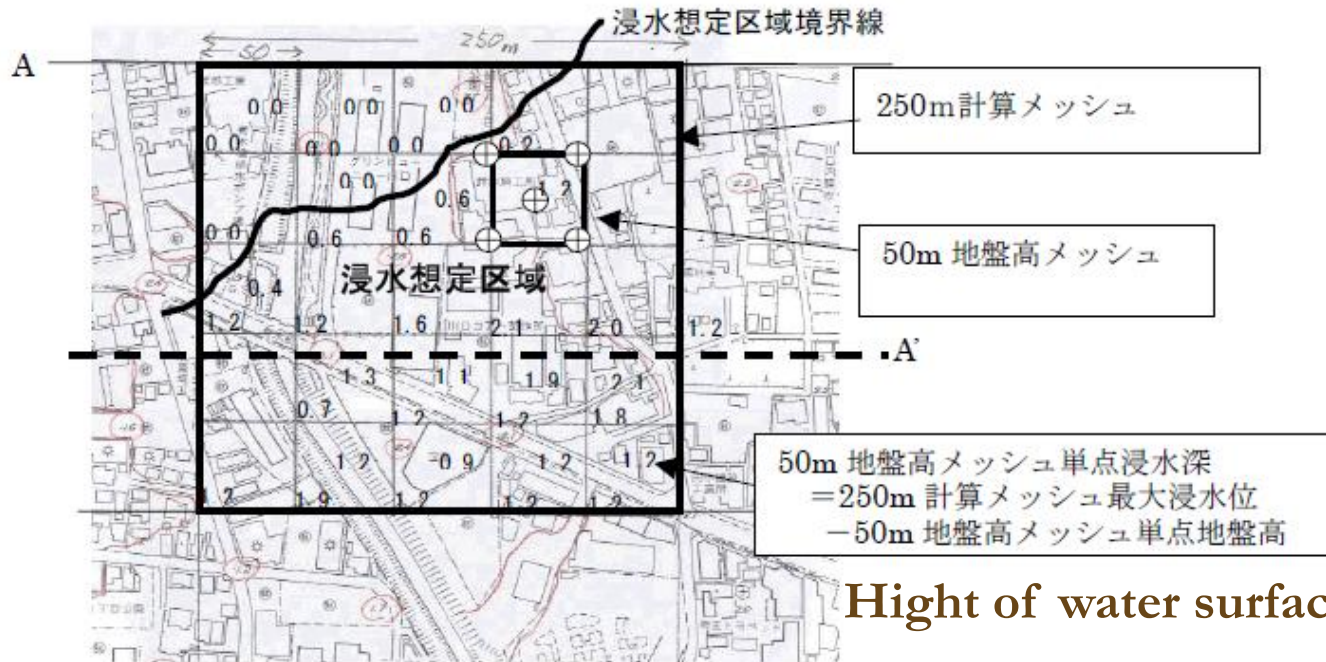
板倉町の医療機関				
	名称	住所	電話	備考
総合病院	板倉町立病院	板倉町1-1	02-2221-2101	
総合病院	板倉町立病院	板倉町1-1255	02-2221-2101	
片上野内科診療所	板倉町立116	板倉町1-121	02-21-1121	
いたくち内科診療所	板倉町1-1-2	70-4500		
板倉町立診療所	板倉町1-1-2	80-4153		
ふたの内科診療所	板倉町1-405	91-4570		
板倉町立診療所	板倉町1-1-1	77-1577		

板倉町の防災関係機関		電話番号 (0292)	FAX 番号	備考
板倉町消防団	板倉3076	82-1111	82-1300	
板倉町消防団消防車第1番	板倉3075	82-1138	82-1387	
板倉町消防団消防車第2番	板倉1104	82-1135		
板倉町警察 板倉地区警察分署	板倉3077	82-1130		
板倉町警察 板倉地区交番	板倉3171-5	82-1586		
板倉町役所	板倉1312	82-0001		
板倉町立公民館	板倉1001-1	82-0224		
板倉町立図書館	板倉1311・1317	82-3900		
「ふれあいセンター 板倉公民館」	板倉1003	82-123		
板倉24時間生活センター	板倉1002	82-0820		
板倉町立特別支援学校 板倉南特別支援学級	板倉3171-3	82-1818		



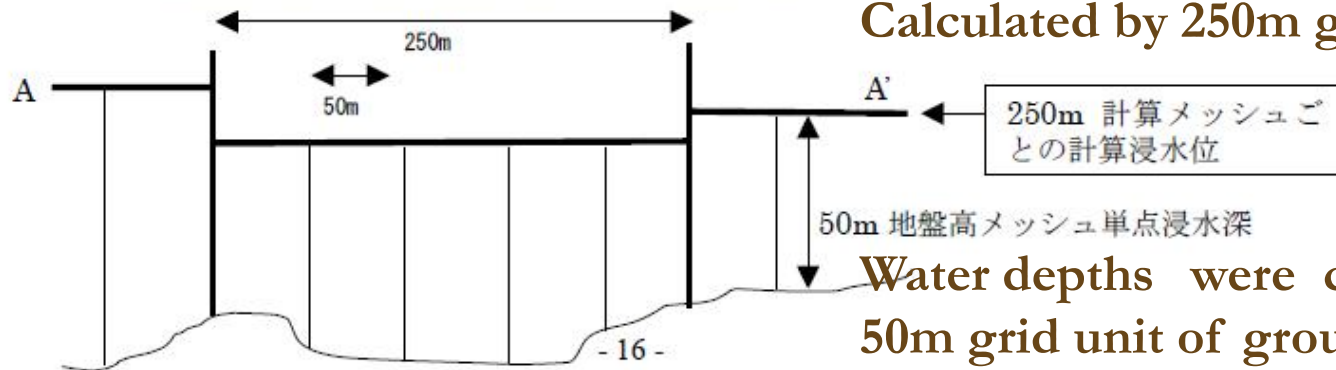
Water depth calculated unit

making flood area simulation maps



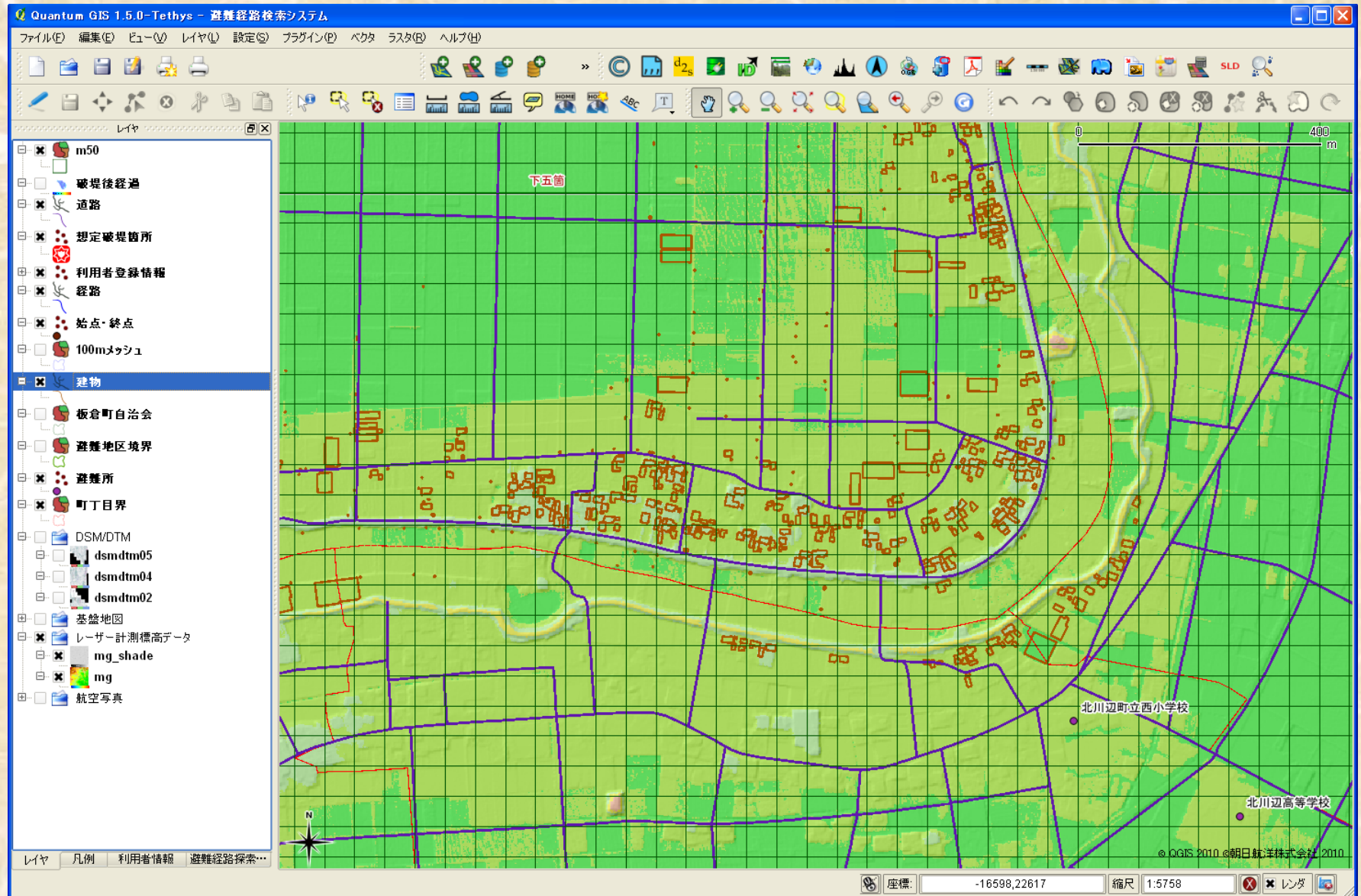
Hight of water surface were

Calculated by 250m grid unit

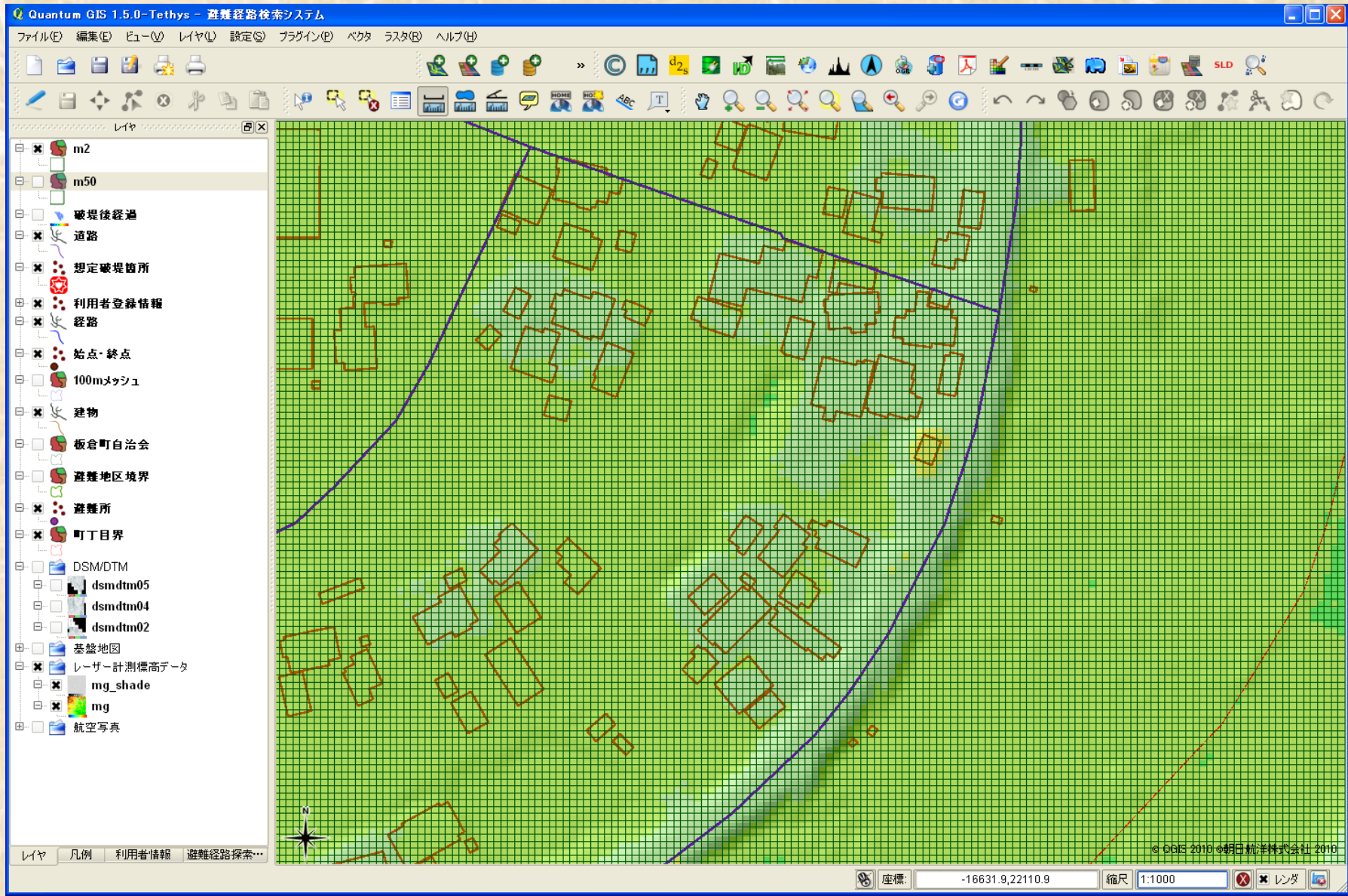


Water depths were calculated by
50m grid unit of ground elevation

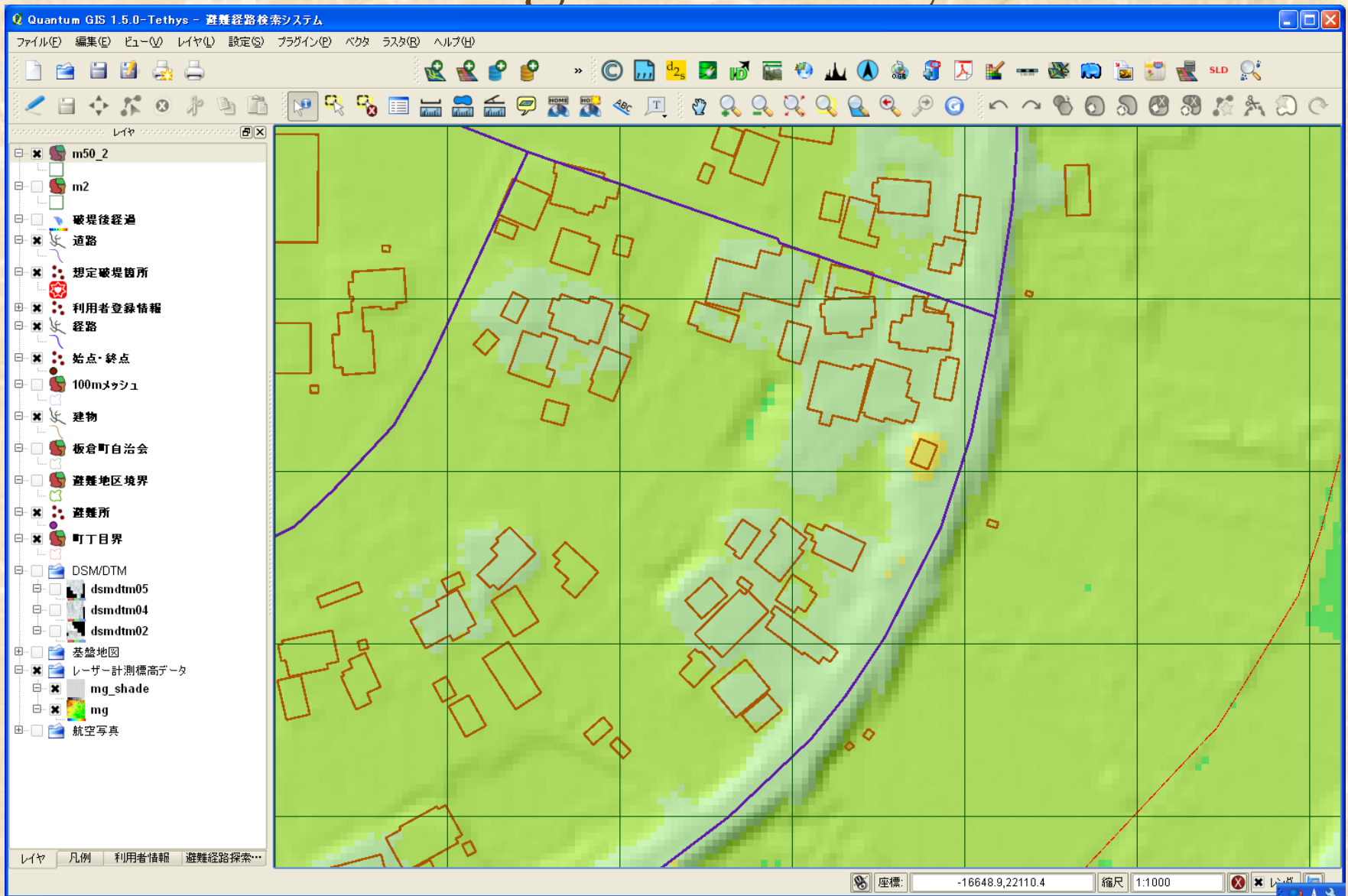
50m grid overlay



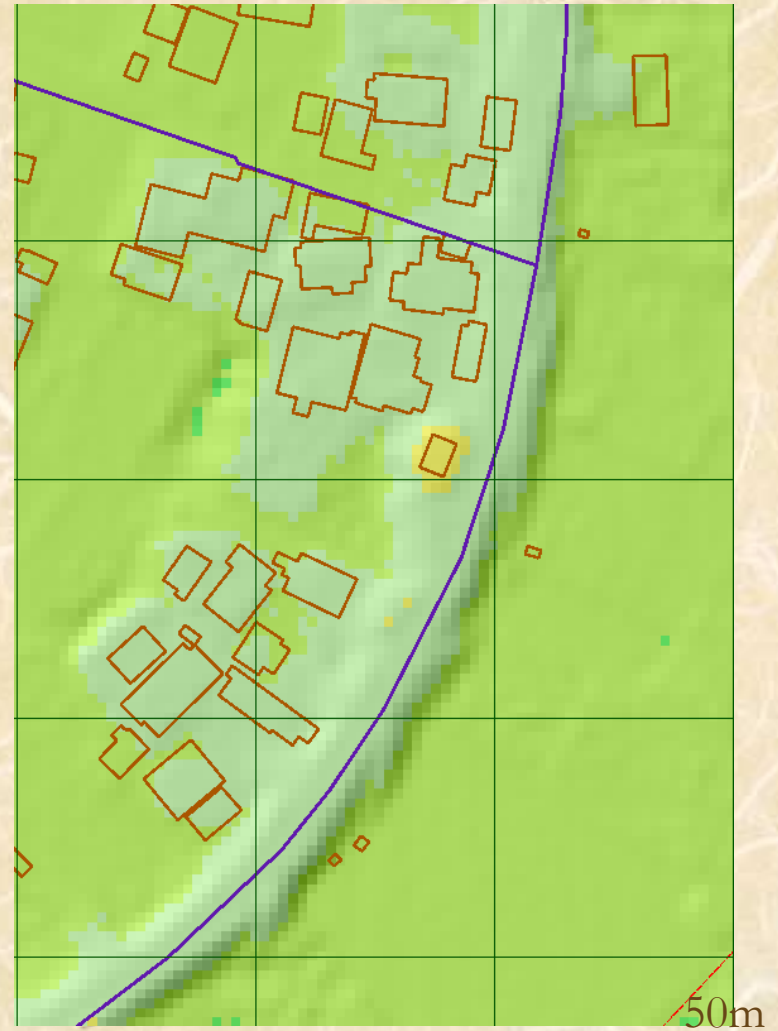
2m grid overlay



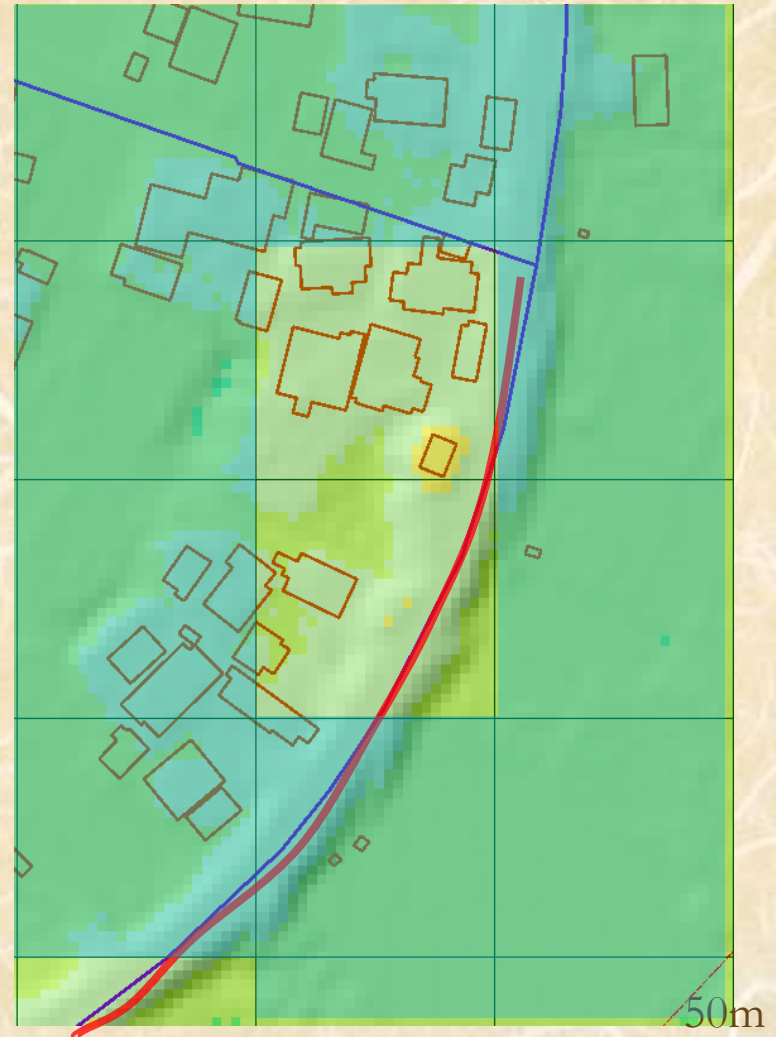
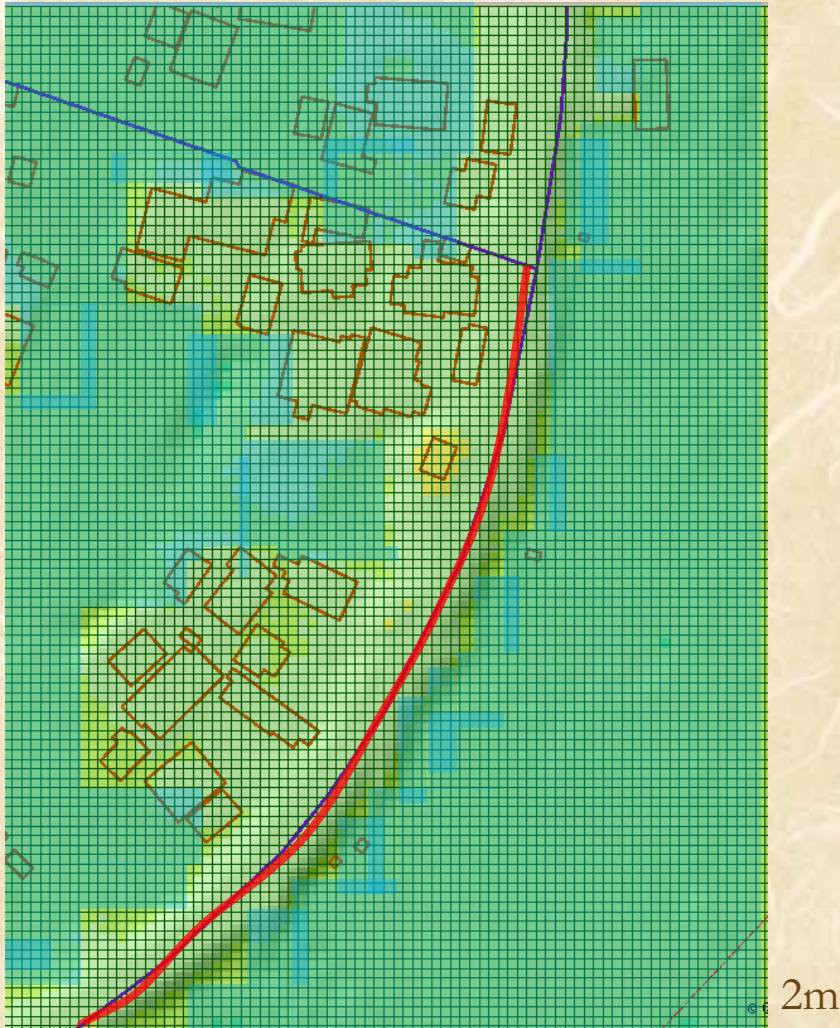
50m grid overlay



Compare 2m grid and 50m grid



using 2m grid ,we could find that such
a road on bank is submerged or not

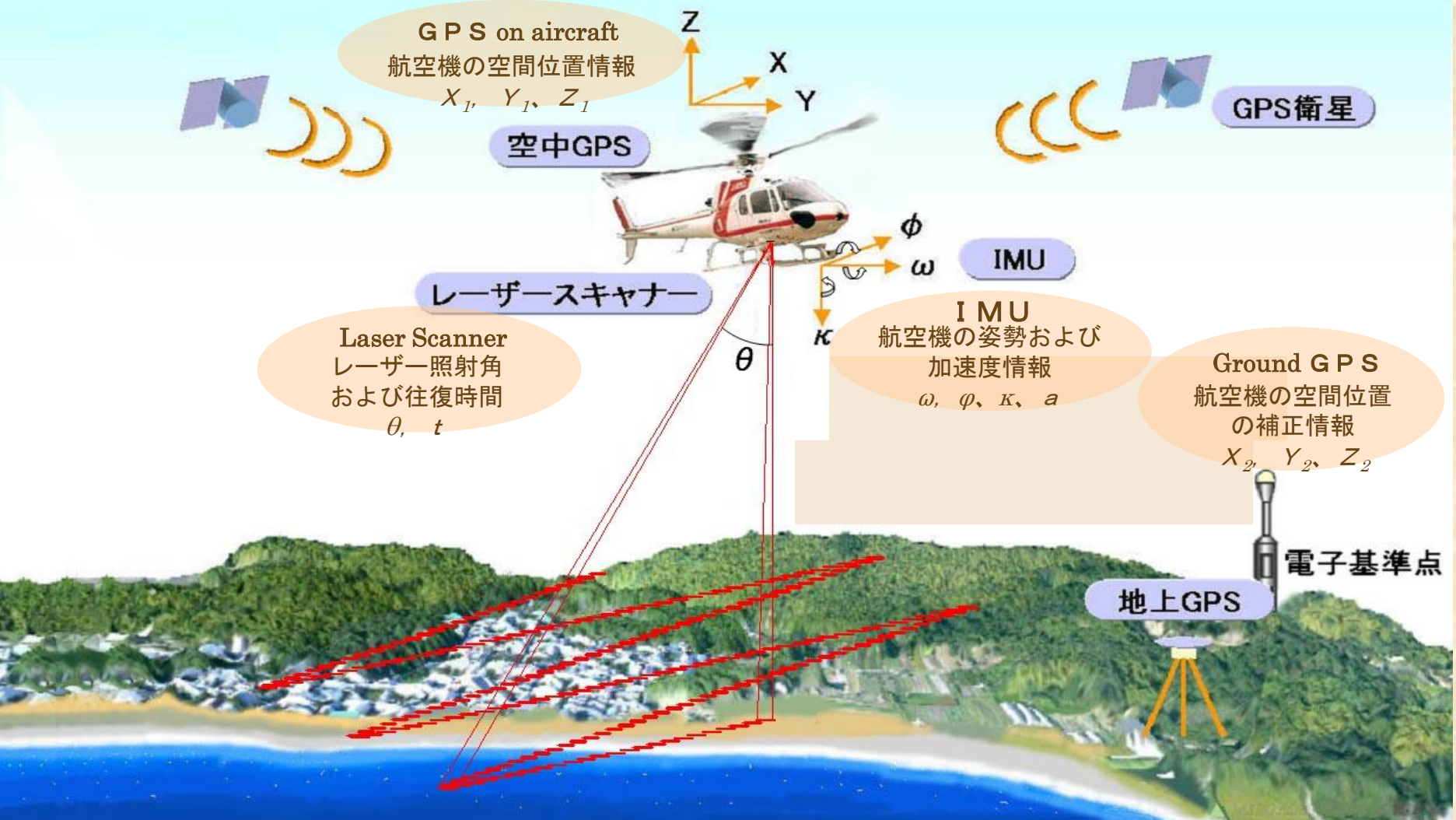


Using fine grid is better

How can we get
such a fine grid elevation
data ?

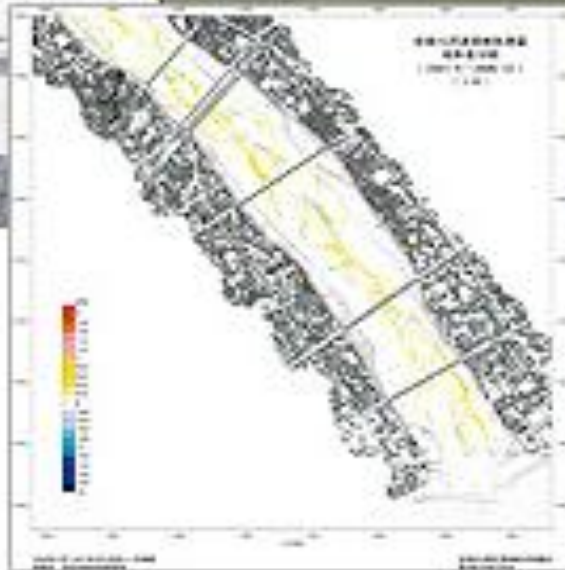
We can get fine grid elevation data using LiDAR system

ALMAPS



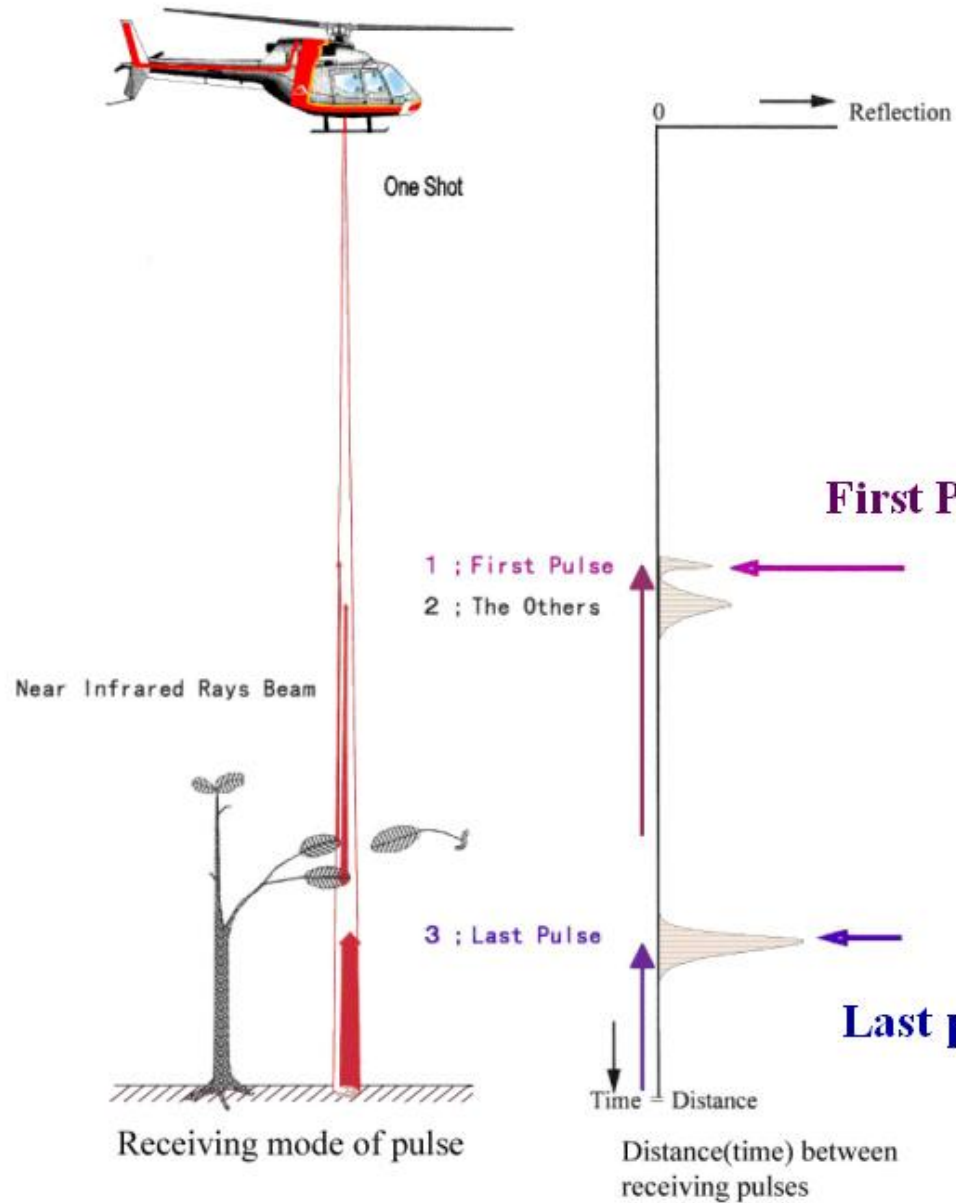
LiDAR System

ALMAPS(Asahi Laser MAPping System/Aerial Lidar Mapping)



計測事例
(河川水位動向)

Types of pulse mode



First Pulse

Last pulse

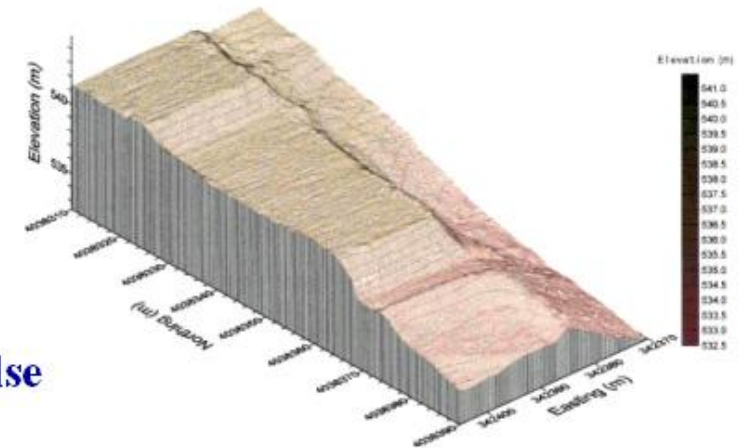
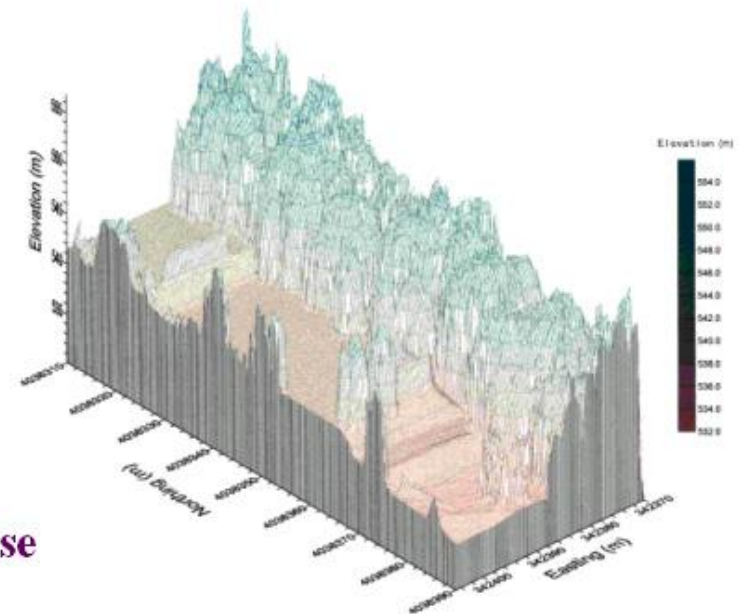
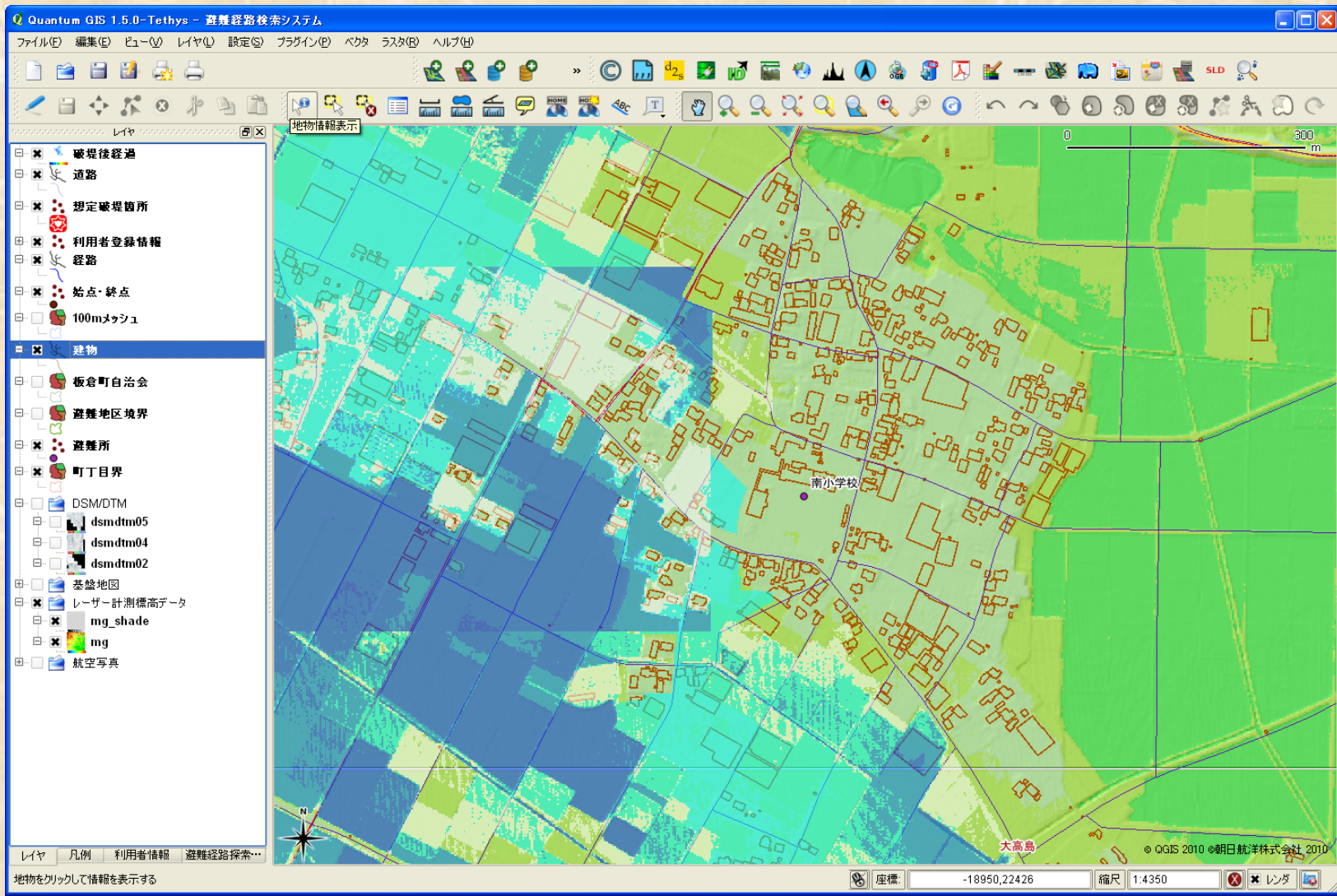


Figure 1: Simulation maps. (A) Map of the study area showing the inundation simulation results. The map displays a grid of 250m calculation mesh and 2m ground elevation mesh. The inundation depth is indicated by the color scale, ranging from 0.0 to 2.0. The inundation area is labeled '浸水想定区域' (Inundation Assumed Area). The map also shows the '浸水想定区域境界線' (Inundation Assumed Area Boundary Line) and the 'A-A' cross-section line.

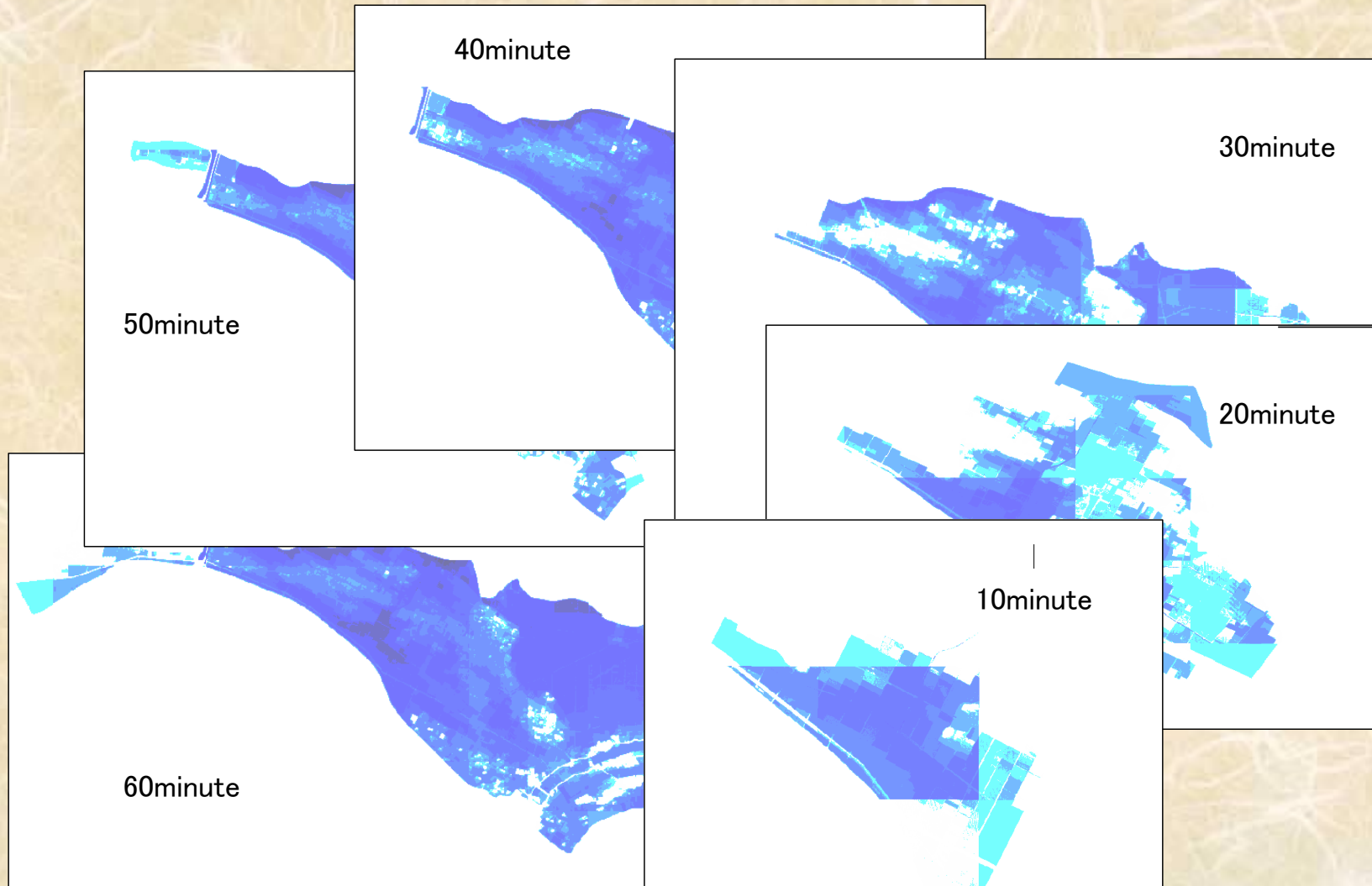
Calculated by 250m unit

Water depths were calculated by 2m unit of ground elevation

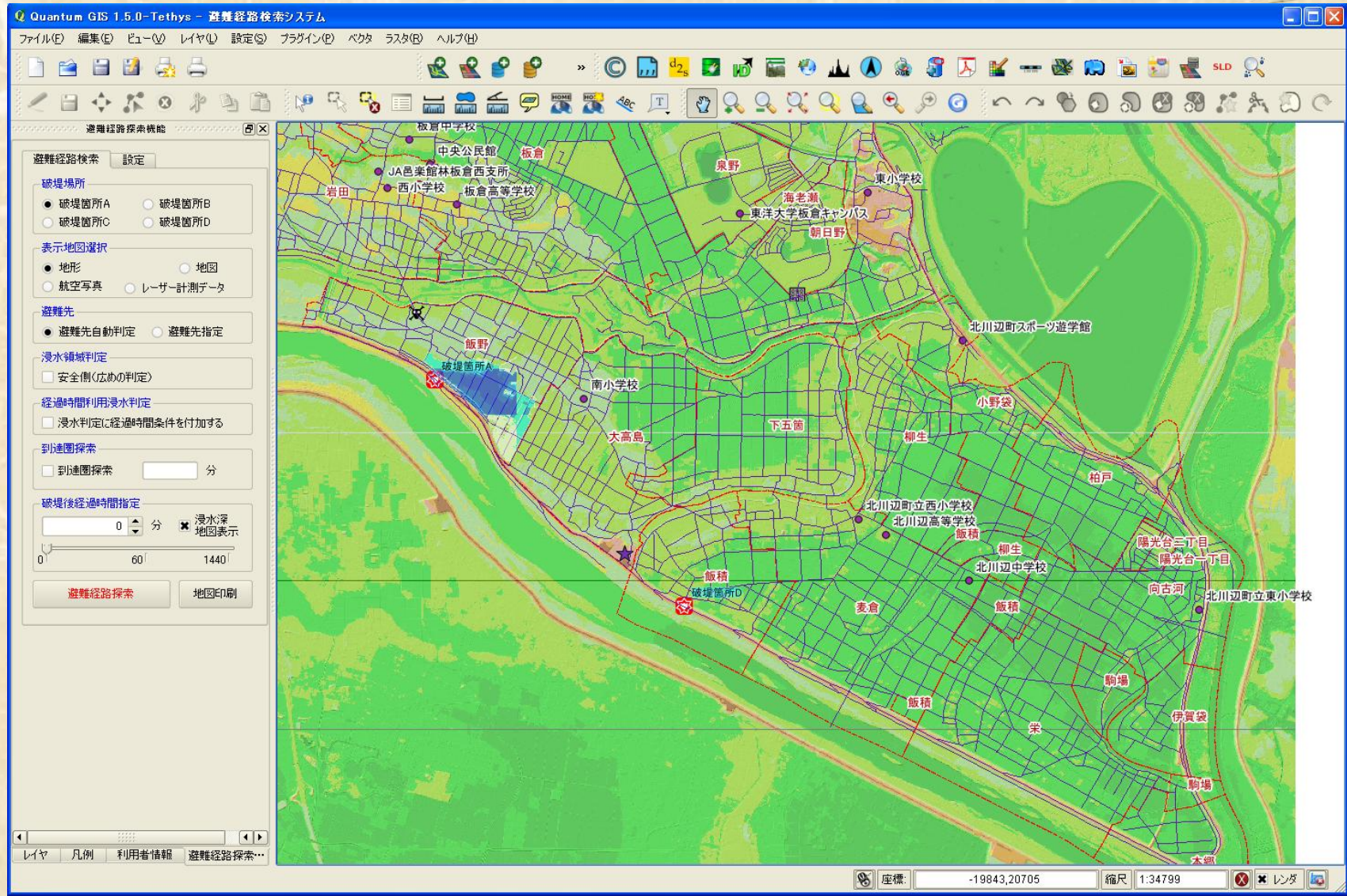
We could get fine flood area map using LIDAR mapping



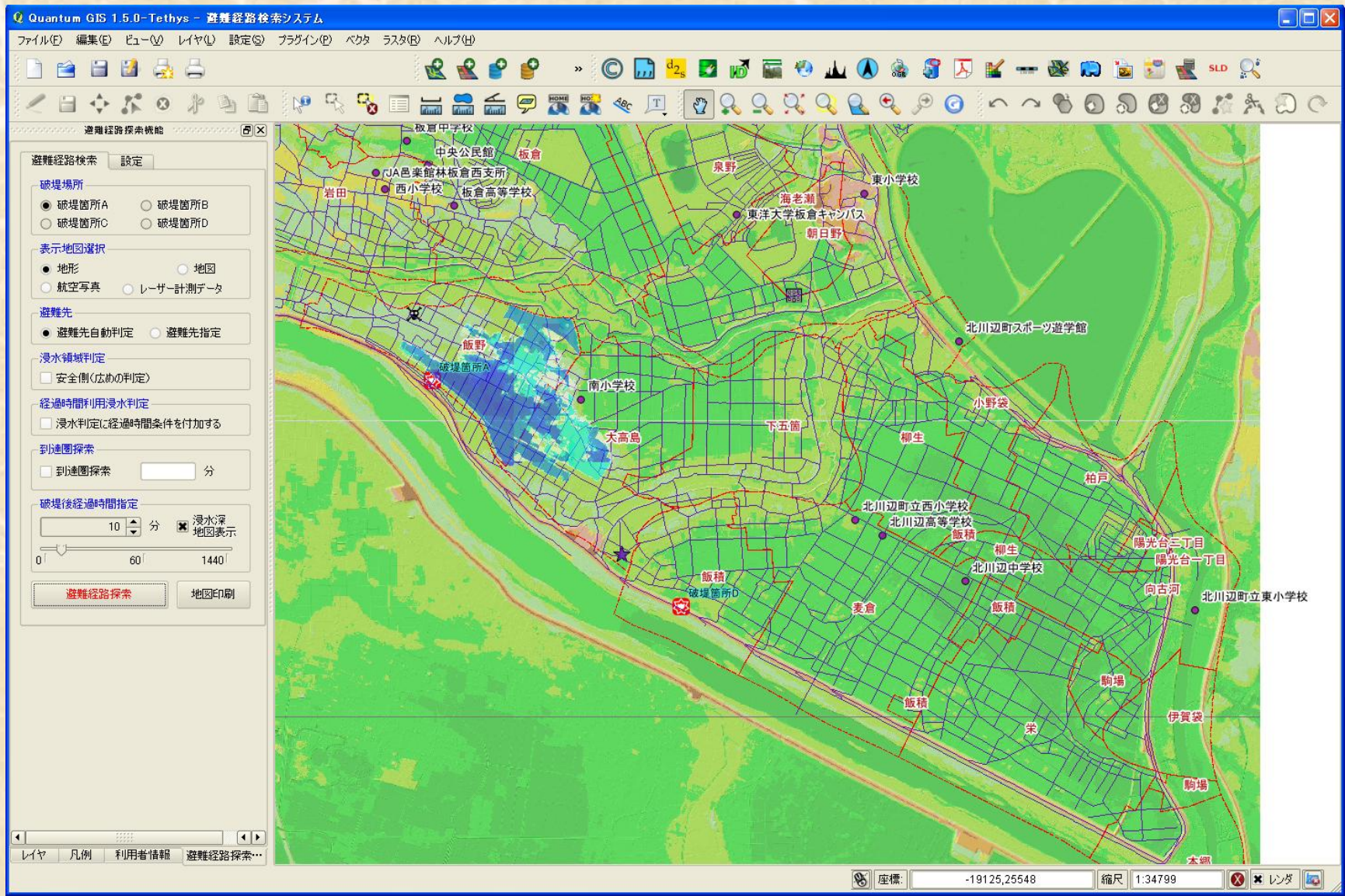
There are many flood area simulation data by 10 minute every assumed place where bank overtopping



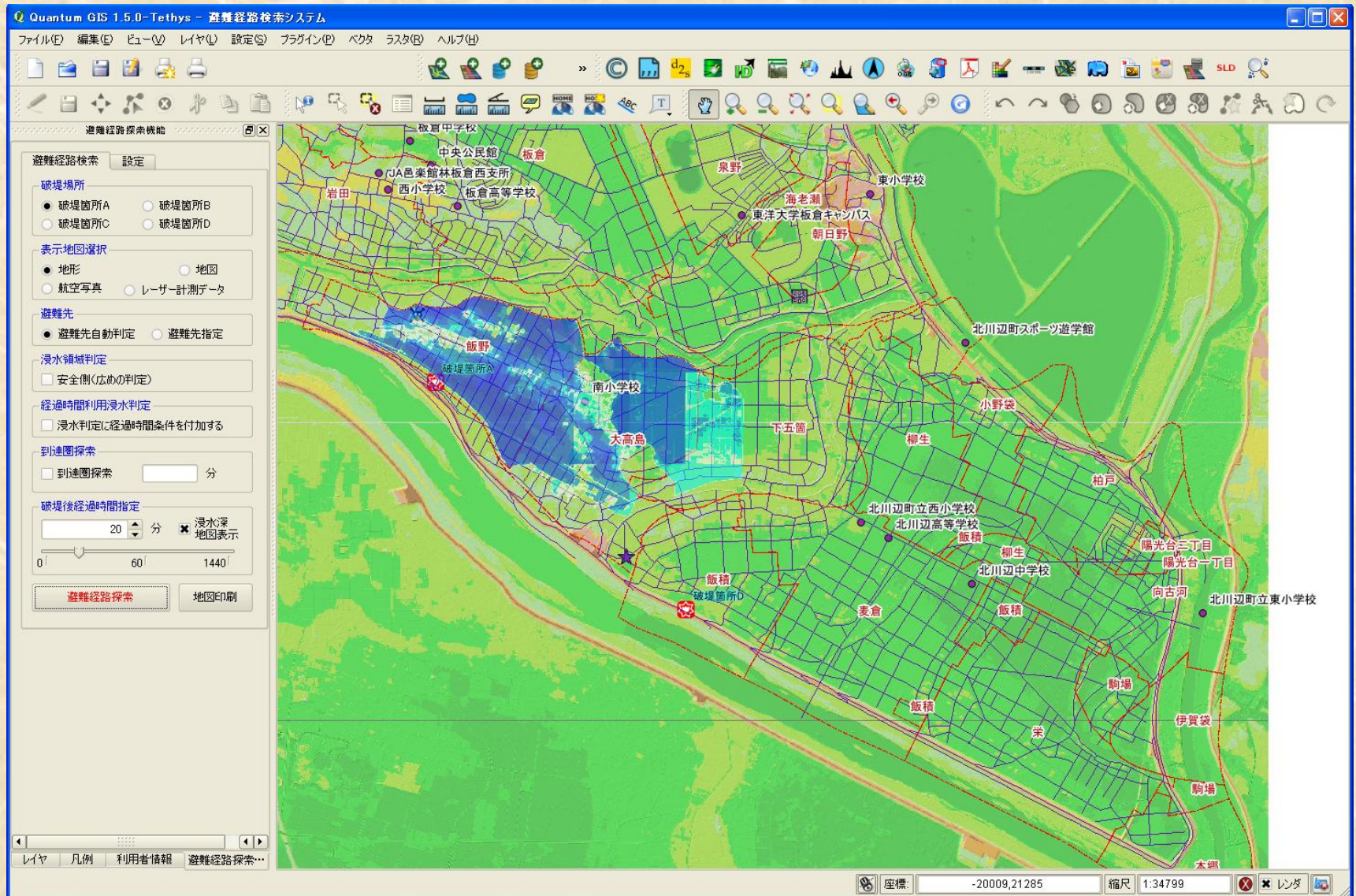
We can see assumed flood area vary with time



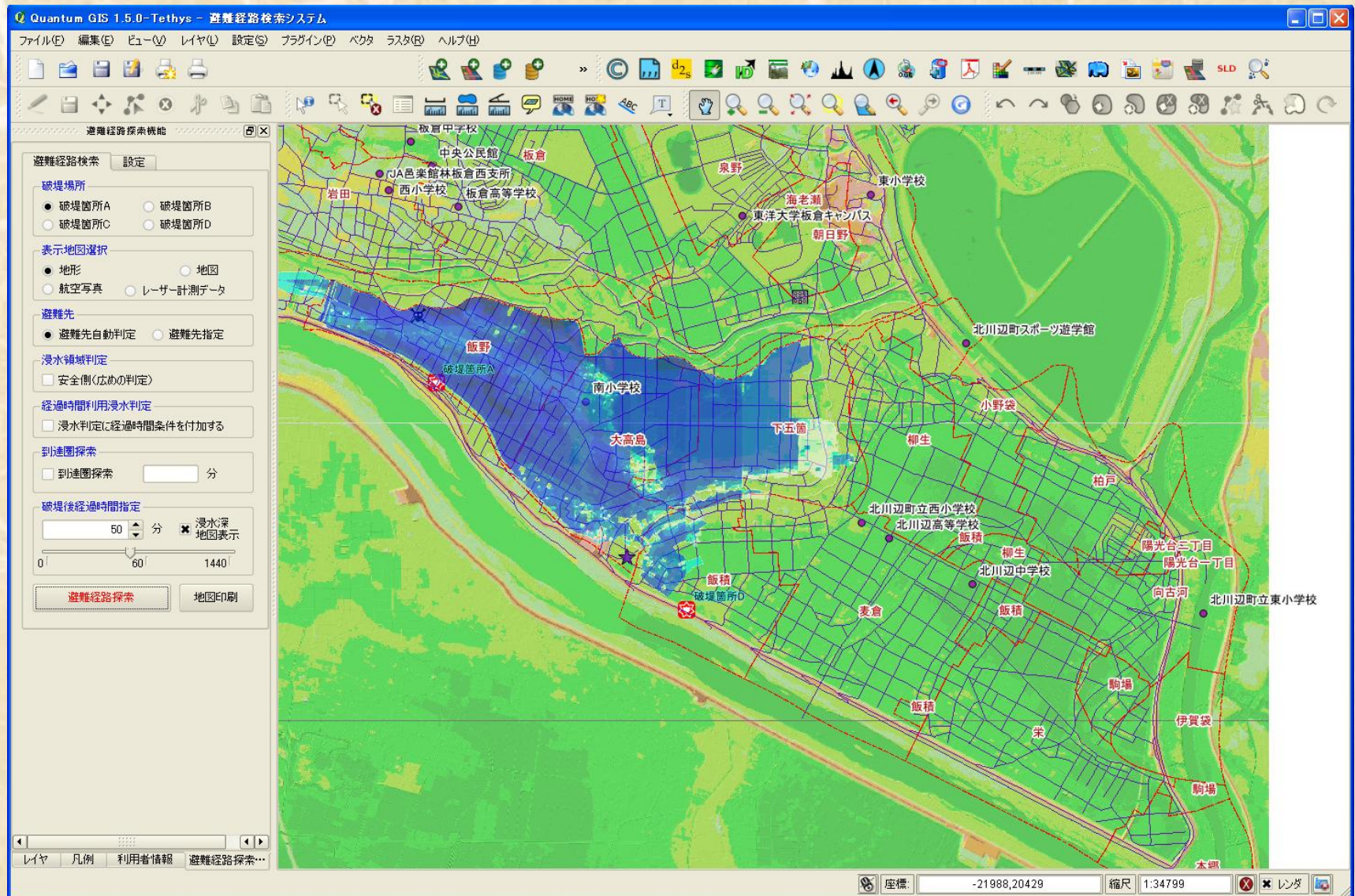
10 minutes later after overflow



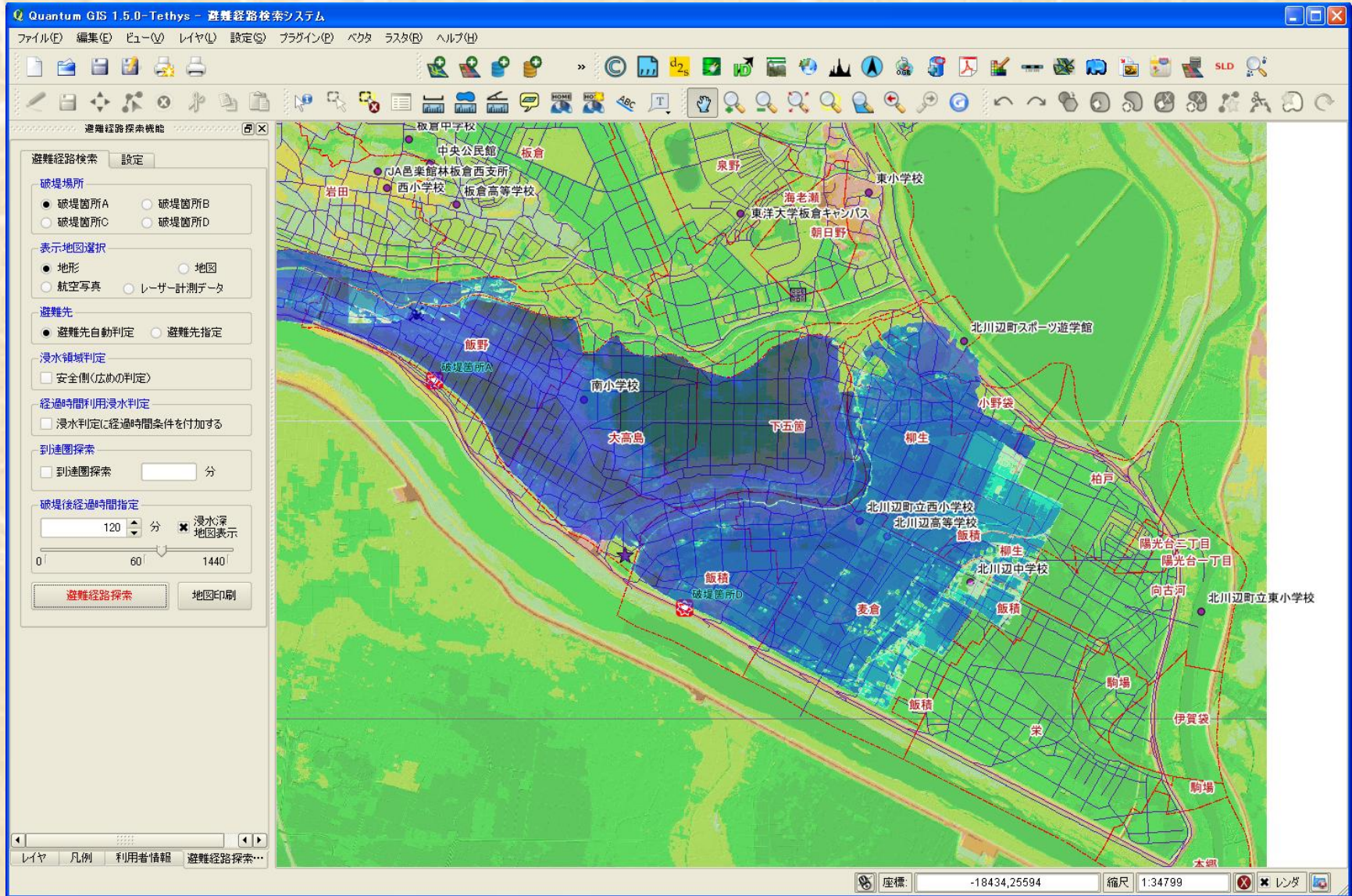
20 minutes later after overflow



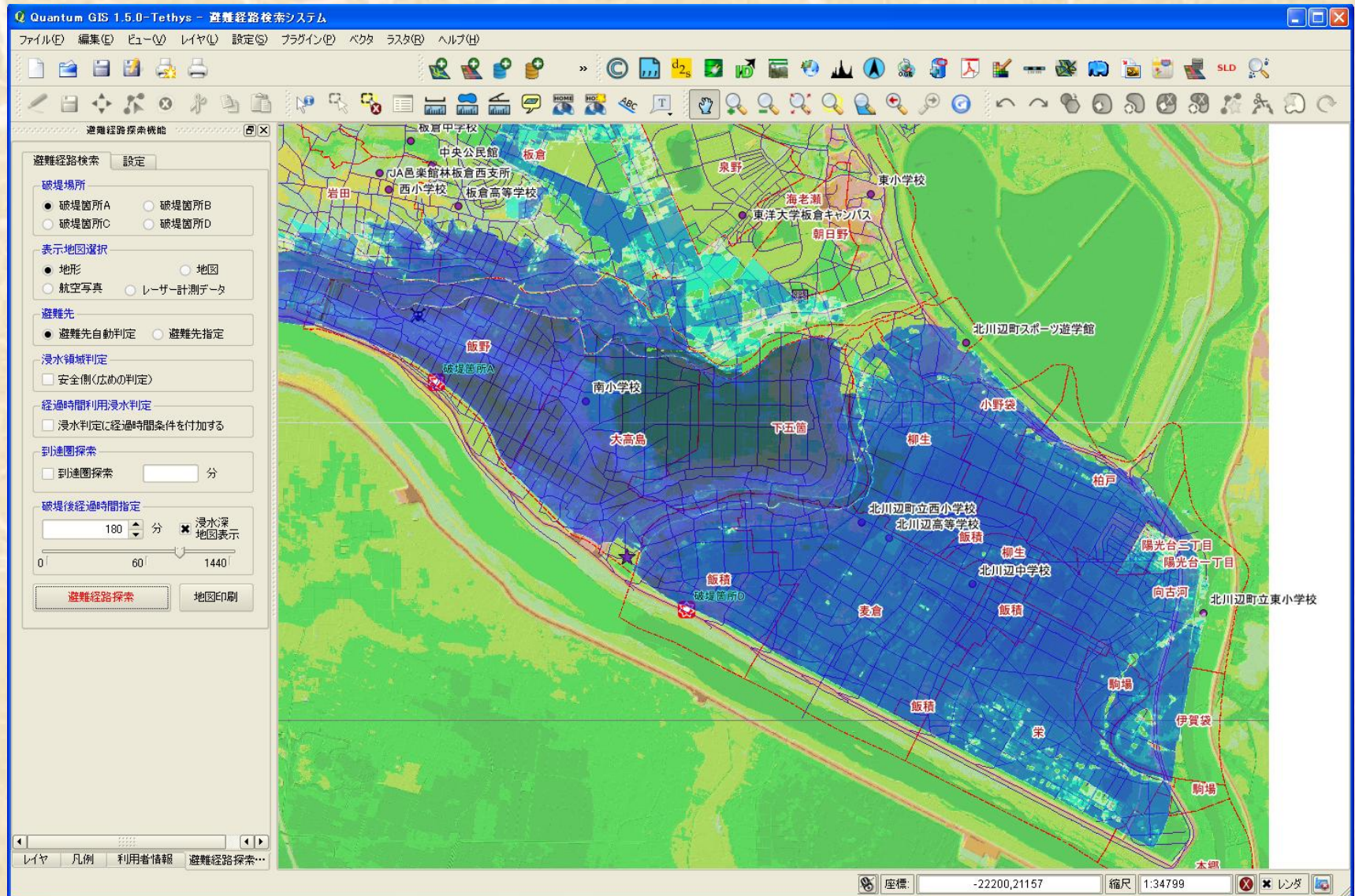
50 minutes later after overflow



120 minutes later after overflow

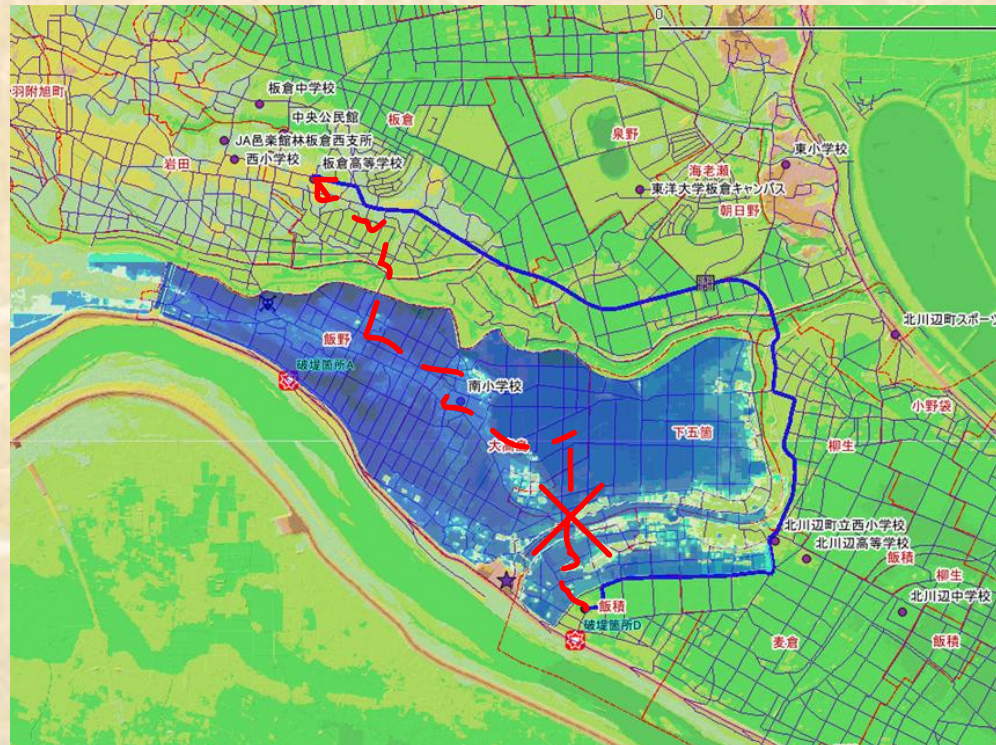


180 minutes later overflow

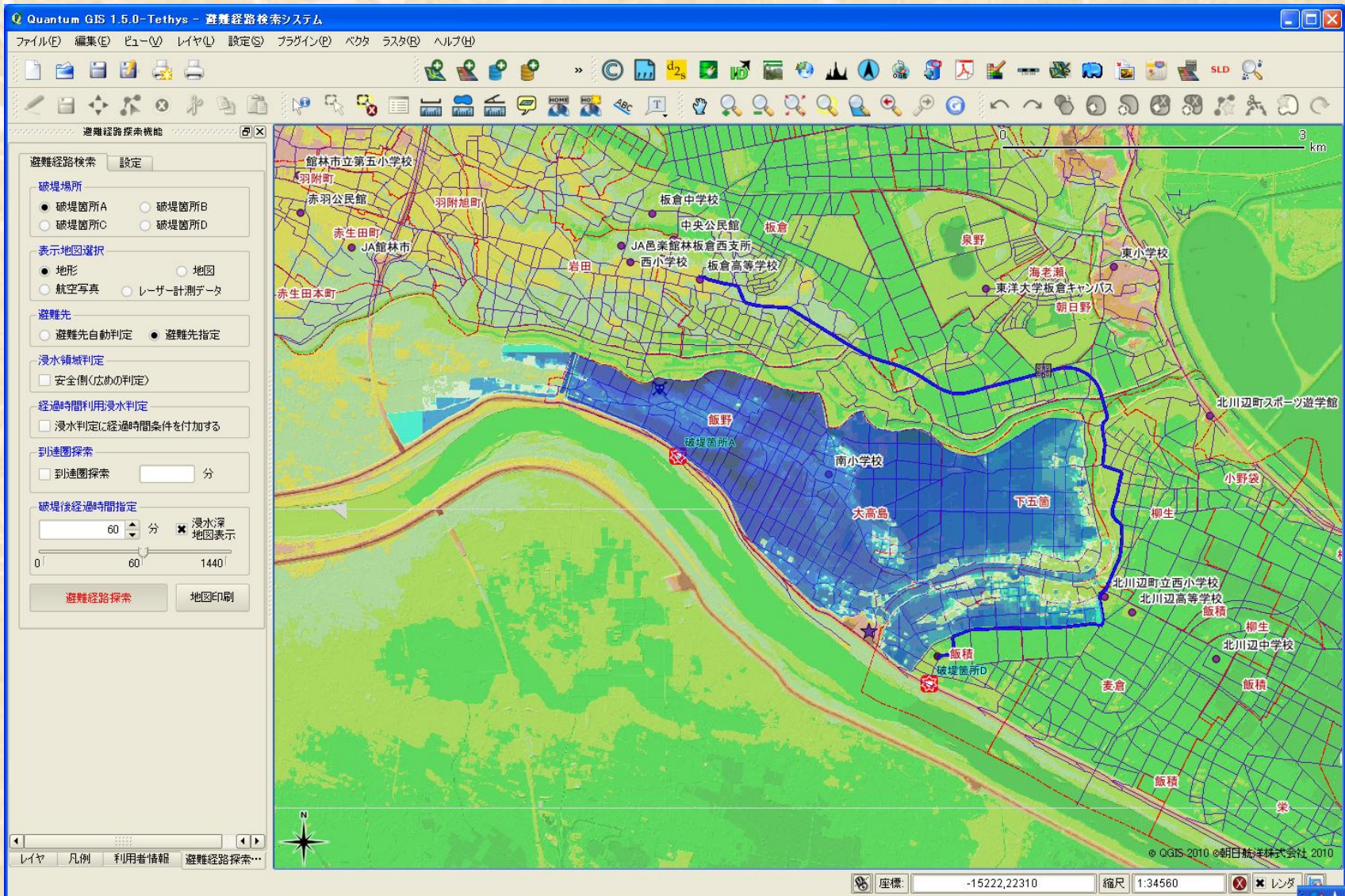


Using such fine flood area data

- If we have network data of roads, I thought perhaps I could make a program of searching route system, without roads of submerged.



How can I make such system?



When we would make a system about searching route,

- I think, using pgRouting is a best solution .



pgRouting

http://pgrouting.postlbs.org/

google

その他のブックマーク

Search

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Start Page Index History Last Change

Welcome to pgRouting Project

日本語

This project's main objective is to provide routing functionality to [PostGIS](#) / [PostgreSQL](#). pgRouting is part of [PostLBS](#), which provides core tools for Location Based Services (LBS) as Open Source Software (OSS). Its tools are similar to those found on proprietary software.

Get pgRouting

- pgRouting 1.03 [source .tgz](#)
- pgRouting 1.02 [source .tgz](#) | [win32 .zip](#)
- pgRouting 1.01 bugfix release [source .tgz](#)
- pgRouting 1.0 release [source .tgz](#) | [win32 .zip](#)
- [ReleaseNotes](#)
- [Older versions](#)

Get support

- Developer forum: <http://pgrouting.postlbs.org/discussion>
- Users Mailing List: <http://lists.osgeo.org/mailman/listinfo/pgrouting-users> **NEW**
- Developers Mailing List: <http://lists.osgeo.org/mailman/listinfo/pgrouting-dev> **NEW**

To add new tickets, post messages on the discussion lists or to help with documentation, you need to [register an account](#) and [login](#).



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Quick Links:

- Documentation -- Overview
 - Installation
 - Data Preparation
 - Data Processing
 - Data Output

pgRouting is an excellent program for searching shortest path route

The screenshot shows the Ride the City New York website interface. The browser address bar displays <http://www.ridethecity.com/>. The page header includes the site logo, navigation links (route options, feedback, tools, blog, jobs, register / login), and weather information (81° F and cloudy in New York).

Route Information:

- where from?** [W 3rd St, Manhattan]
- where to?** [40th Ave, Queens]
- Safer route:** ☐
- go**

Route Summary:

- Total distance:** 5.8 miles
- Time estimate:** 35 – 46 min.
- Elevation gain:** 82 ft

Route Instructions:

- 1) Ride northwest on **W 3rd St** (about 230 feet)
- 2) Right on **Ave Of The Americas** (about 0.2 miles)
- 3) Continue on **Ave Of The Americas** (about 487 feet)
- 4) Right on **W 10th St** (about 0.2 miles)
- 5) Continue on **E 10th St** (about 0.7 miles)
- 6) Left on **1st Ave** (about 0.2 miles)

Map: A map of New York City showing the route from W 3rd St, Manhattan to 40th Ave, Queens. The route is highlighted in green. The map includes a legend, a scale bar, and a compass. The map data is attributed to CloudMade, CCBYSA, and OpenStreetMap.org.

Footer:

- © 2010 Ride the City
- [about us](#)
- [ride the city blog](#)
- [f.a.q.](#)
- [email us](#)
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Logos: Biking Rules, VELOcity, tortis, It's a JOGGING Stroller.

We can add any conditions to the pgRouting search functions as SQL

- Those conditions must be described as SQL of PostGIS/PostgreSQL.
- We can use many spatial relation function at PostGIS.
- So we can add spatial conditions to the search function of pgRouting by using functions of PostGIS.

But !!

- Using stable version of PostGIS, we can use only vector type geometries.
- We have no functions in PostGIS about raster data now.
- LIDAR data and flood area data are raster.
- So we could not use raster flood area data for spatial functions in PostGIS.

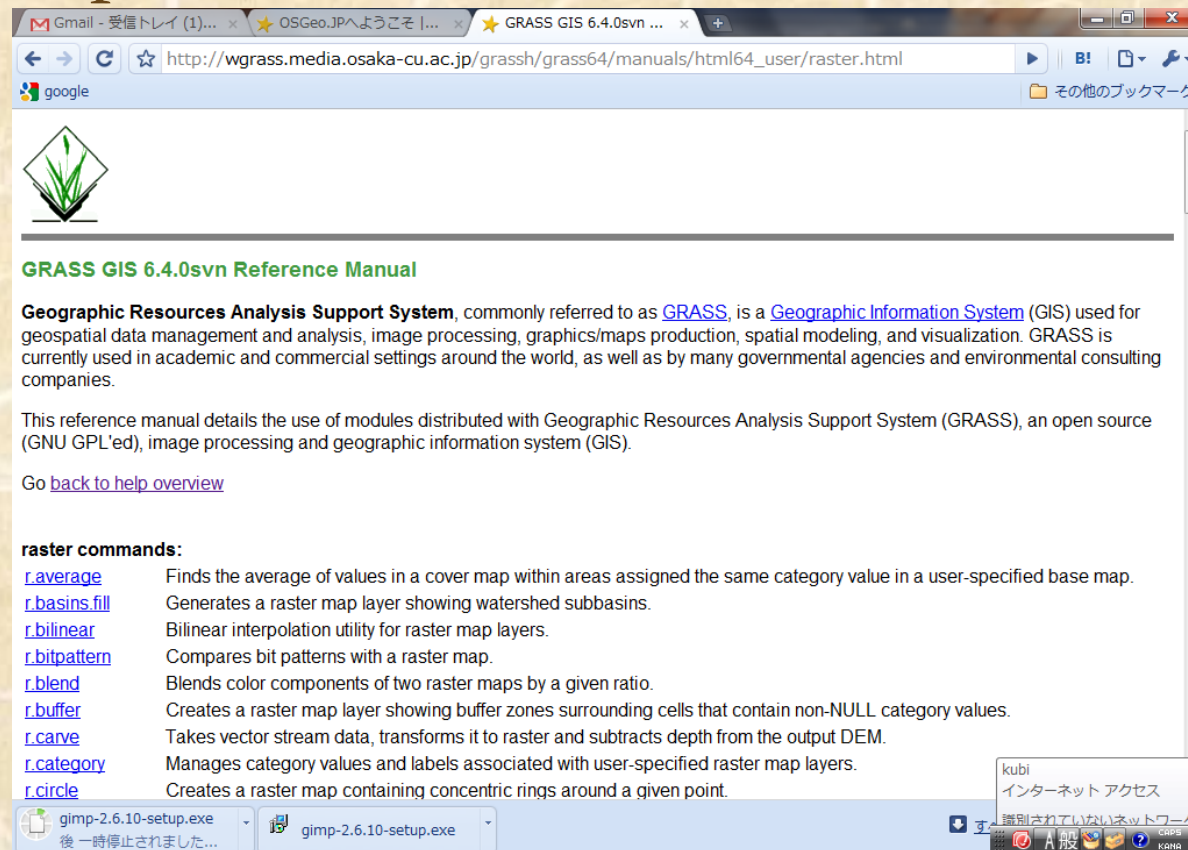
Raster Data

How can I use it with pgRouting?

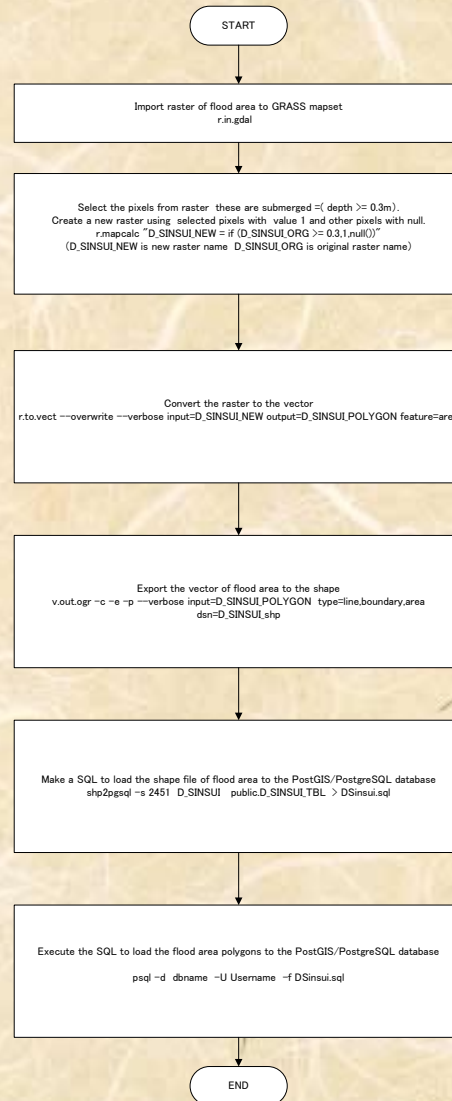
- If I can change raster of flood area to vector, such as polygon, I could use the polygon data for pgRouting function.
- Are there any program ,have such function ?

GRASS

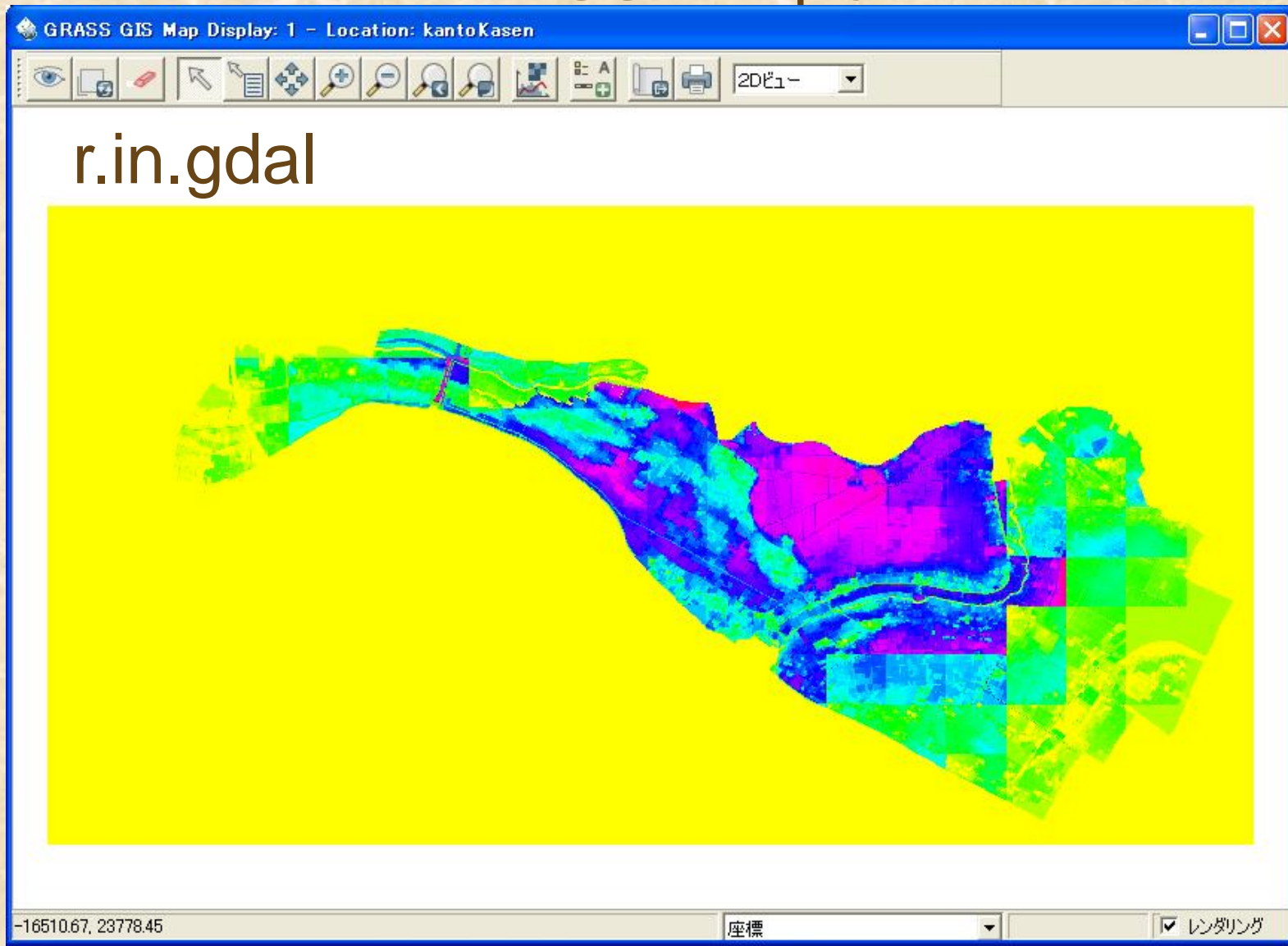
- GRASS has many functions about raster and vector spatial data.



Data conversion process

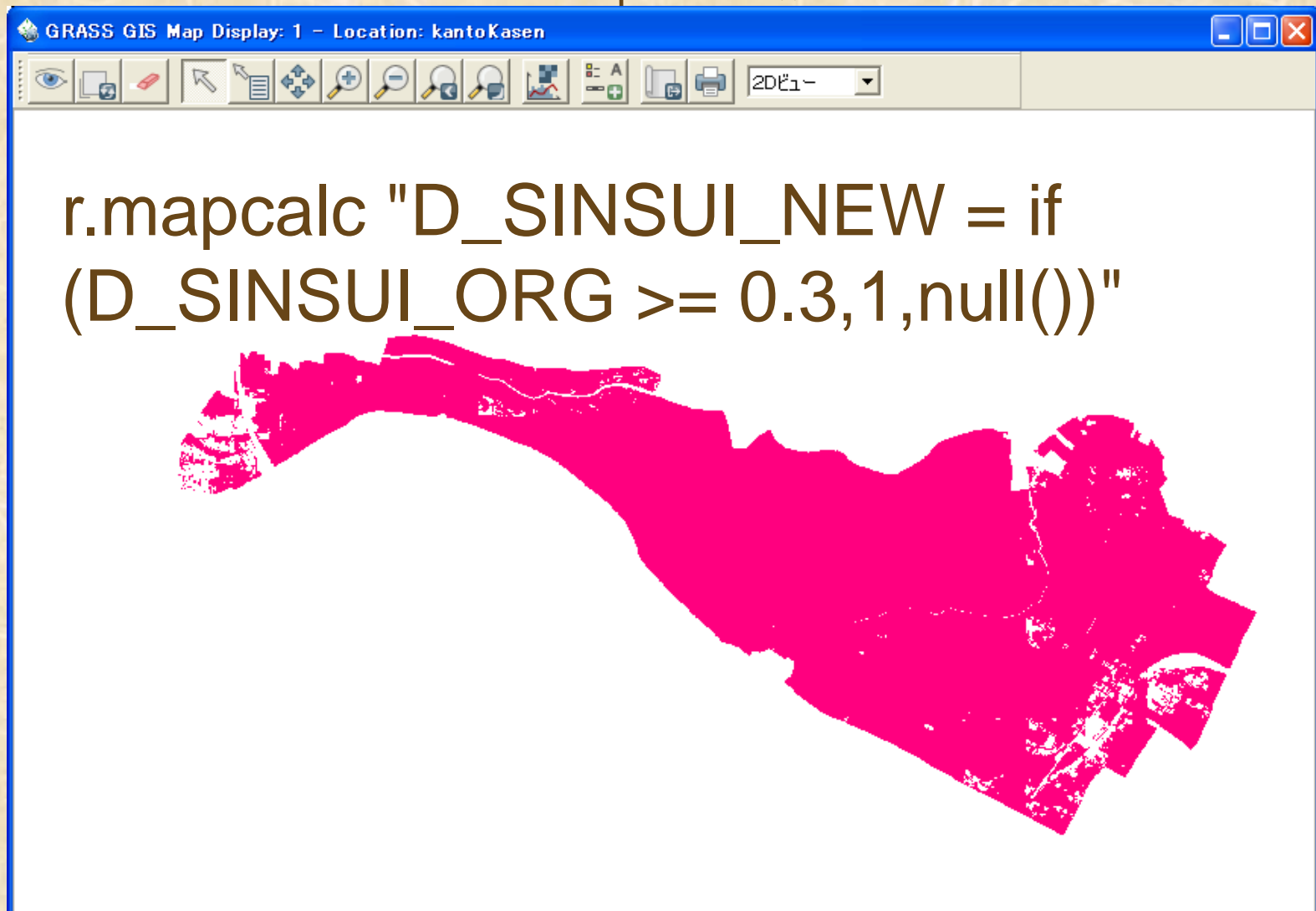


Import raster of flood area to GRASS mapset



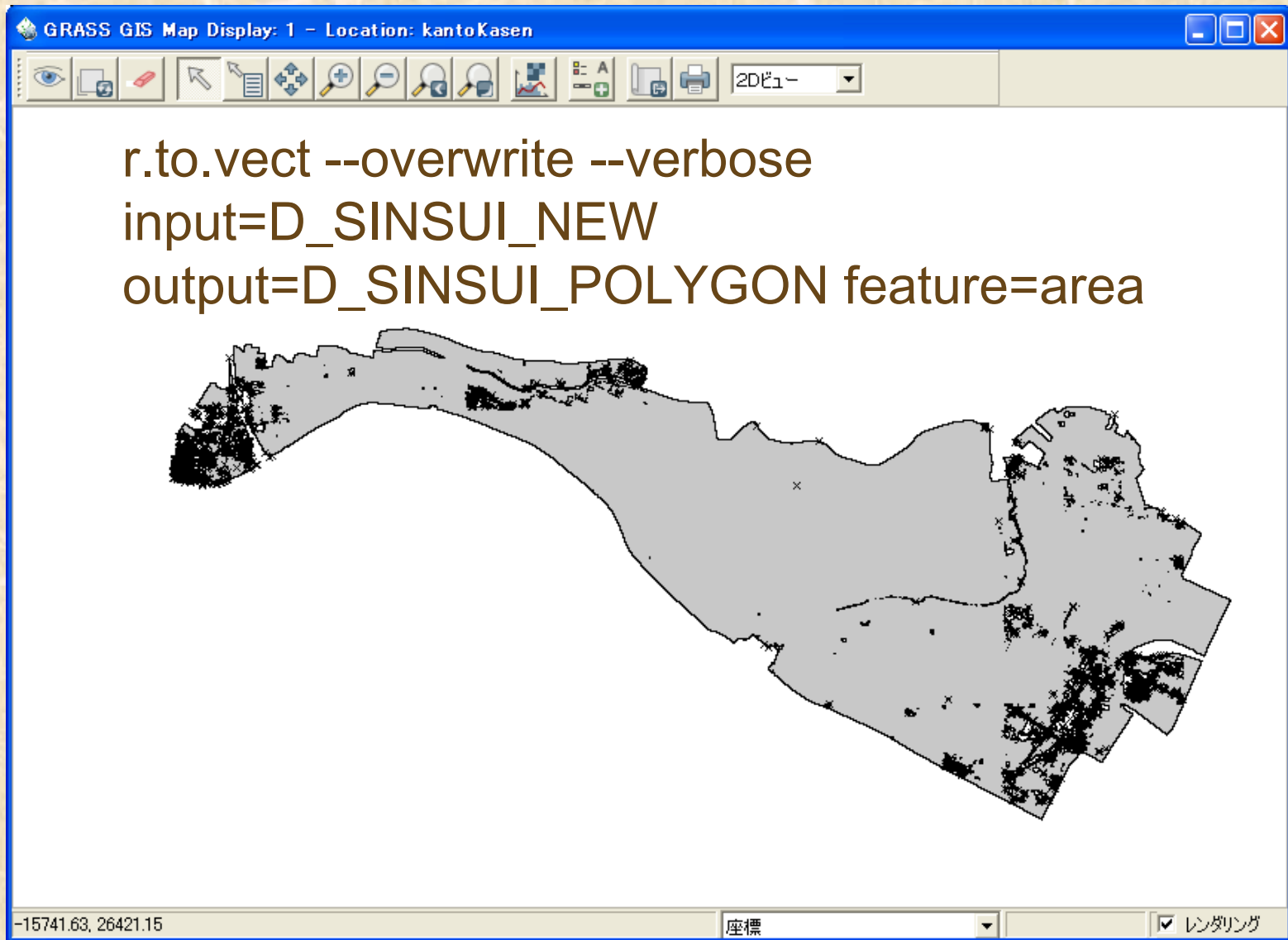
Select the pixels from raster these are submerged = ($\text{depth} \geq 0.3\text{m}$).

Create a new raster using selected pixels with value 1 and other pixels with null.

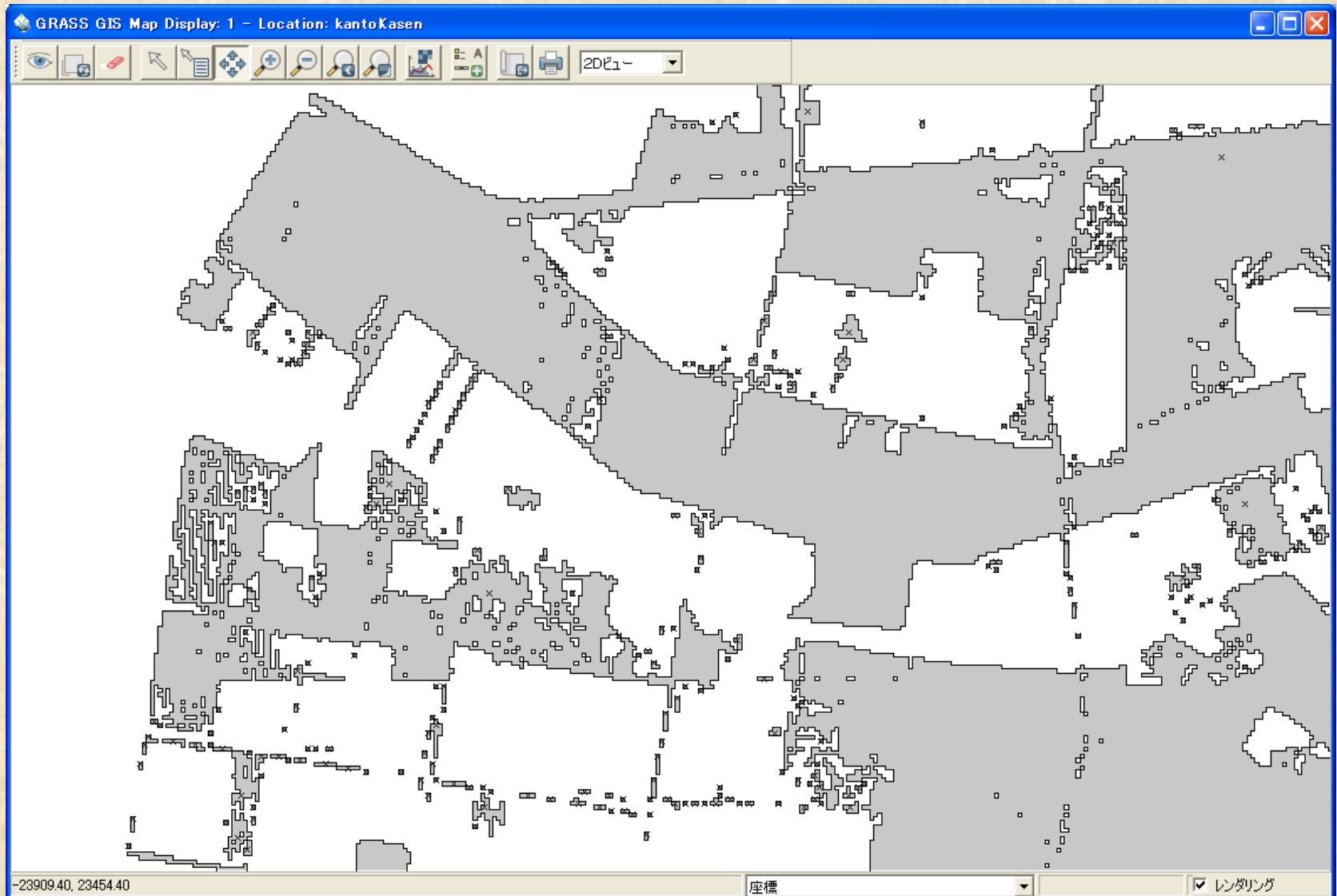


```
r.mapcalc "D_SINSUI_NEW = if  
(D_SINSUI_ORG >= 0.3,1,null())"
```

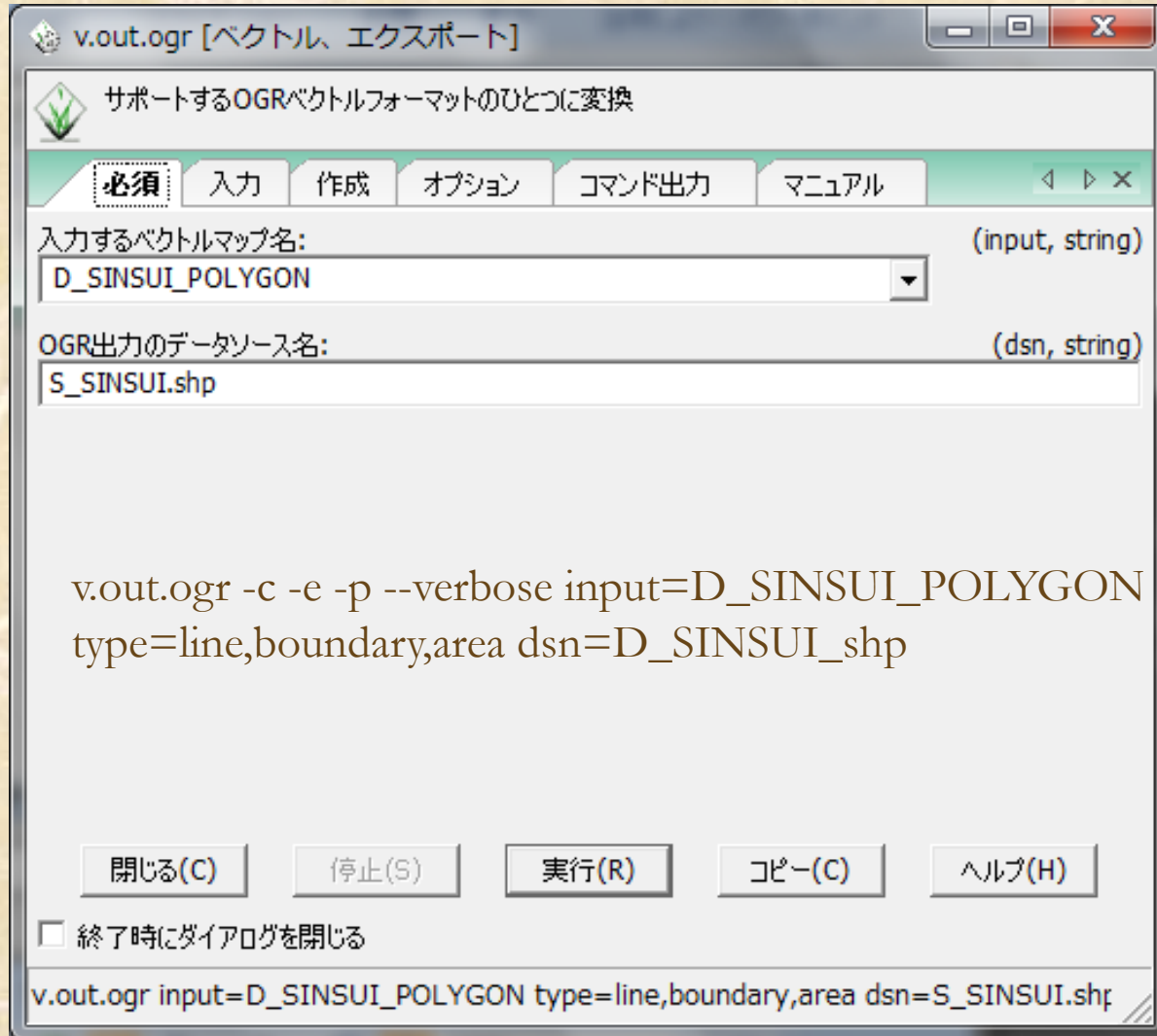
Convert the raster to the vector



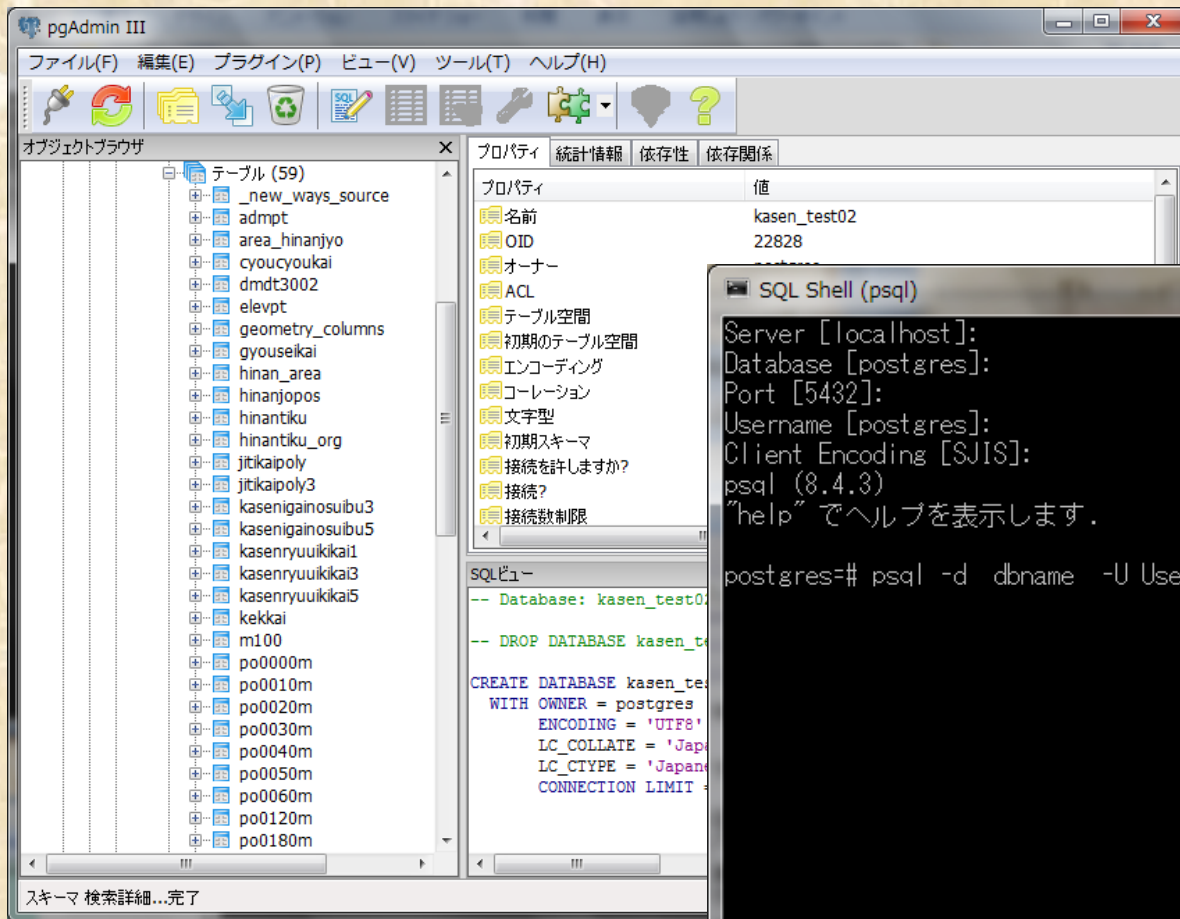
Details of created polygon



Export the vector of flood area to shape file



Load shapfiles to PostGIS/Postgresql database

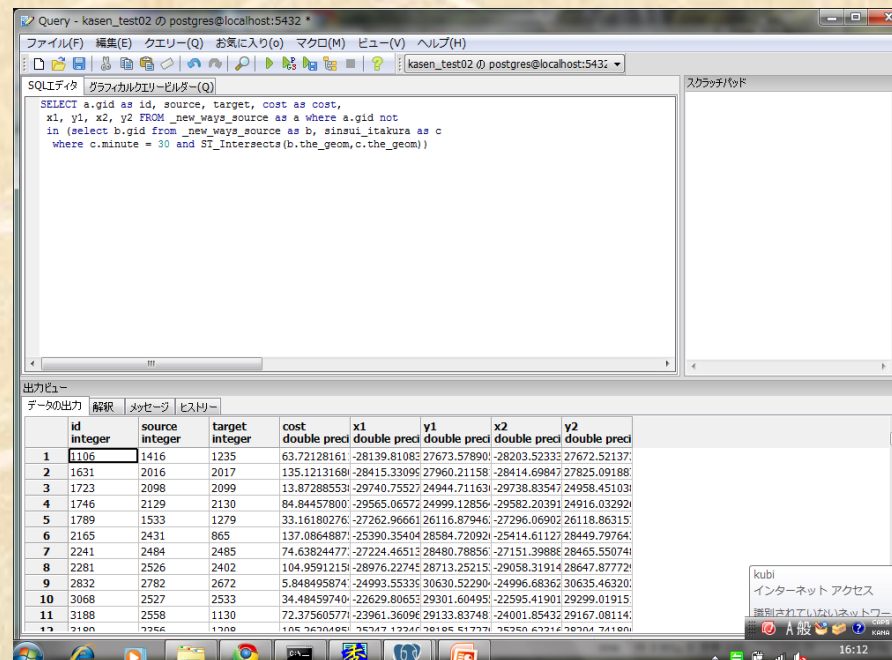


Now we can search using such SQL

```
SELECT vertex_id , edge_id , cost FROM
    shortest_path_astar(                                -- shortest path A star
'SELECT a.gid as id, source, target, cost as cost, x1, y1, x2, y2
  FROM ways as a where a.gid not in( select b.gid from ways as b,
    suishin_polygon_all as c where c.minute = 30
                                -- after 30 minute from bank break
    and ST_Intersects(b.the_geom,c.the_geom))'
                                -- is geometries intersect? a function of PostGIS
,4799, 3962, false, false)
/* source id, target id, directed, has reverse cost */
```


Using pgRouting

- We can search route with network data
- But there are query results strings.
- There are no maps of route using only pgRouting.
- How we can see the maps of routes ?

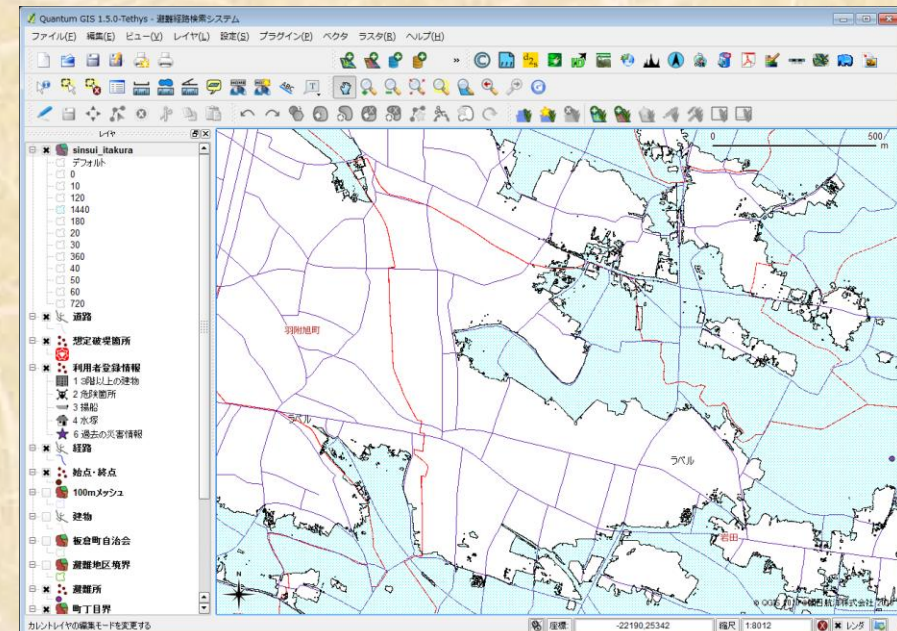


There are many ways of making a map for pgRouting

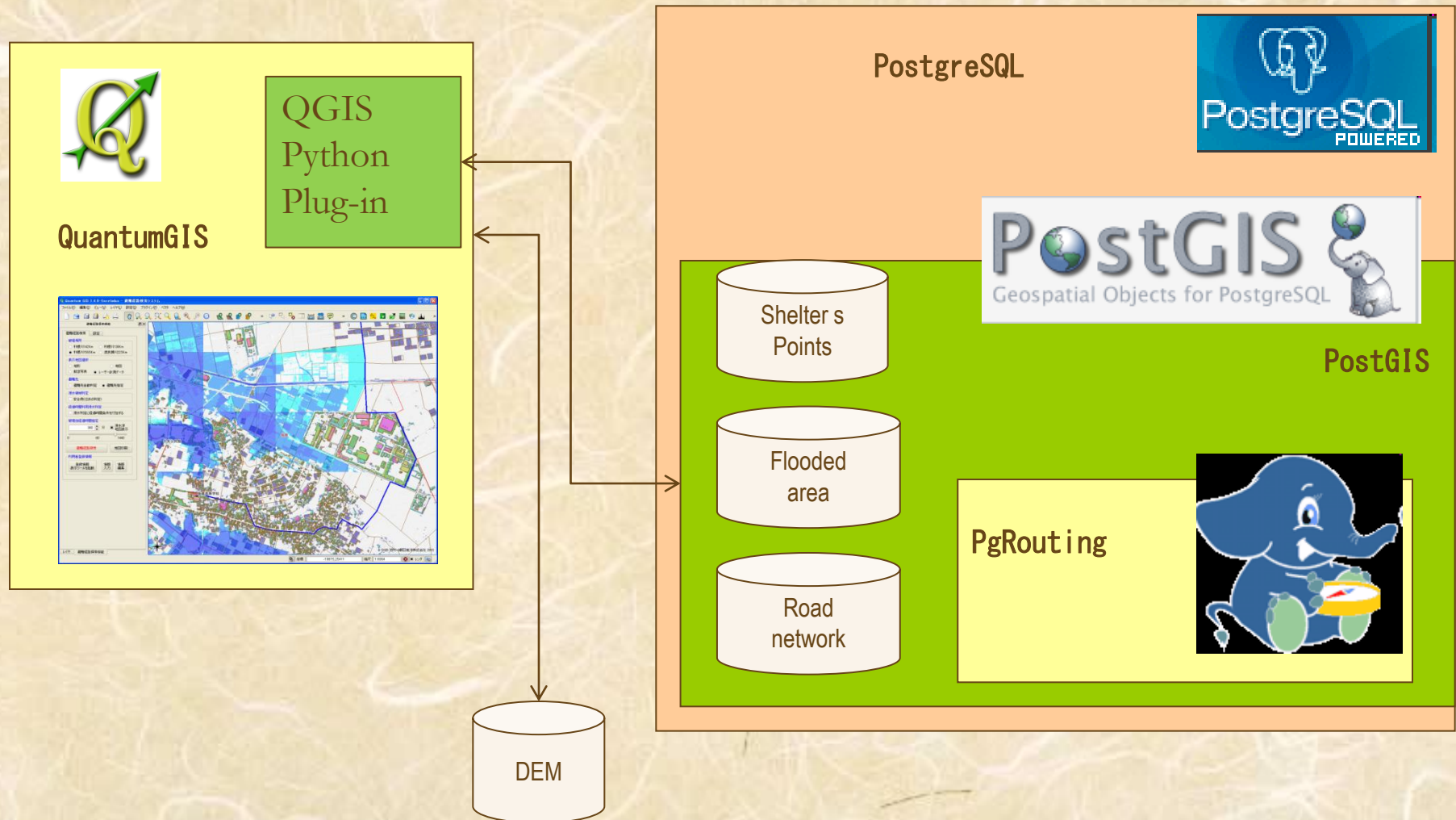
- Web Mapping such as OpenLayers are a cool method.
- There are some good desktop GIS tools such as QGIS, uDig, gvSIG, Open JUMP etc.....
- Perhaps we can see a map, that contains the result of using pgRouting, with such good FOSS4G products.

I used QuantumGIS for this system

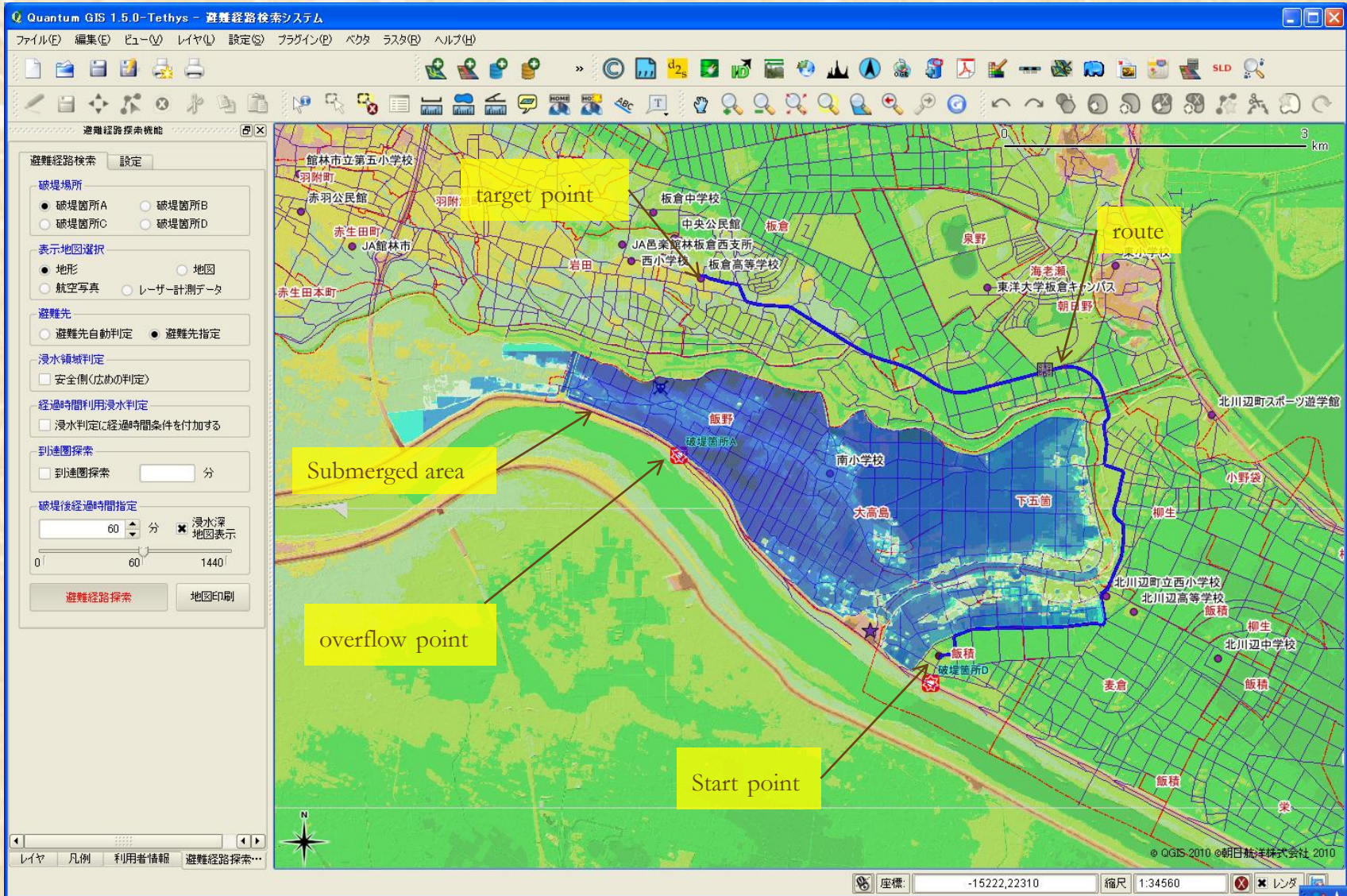
- Stand alone use(without internet) is required
- There are Japanese GUI(we transrated)
- We can add functions as external plug-in program to QuantumGIS.



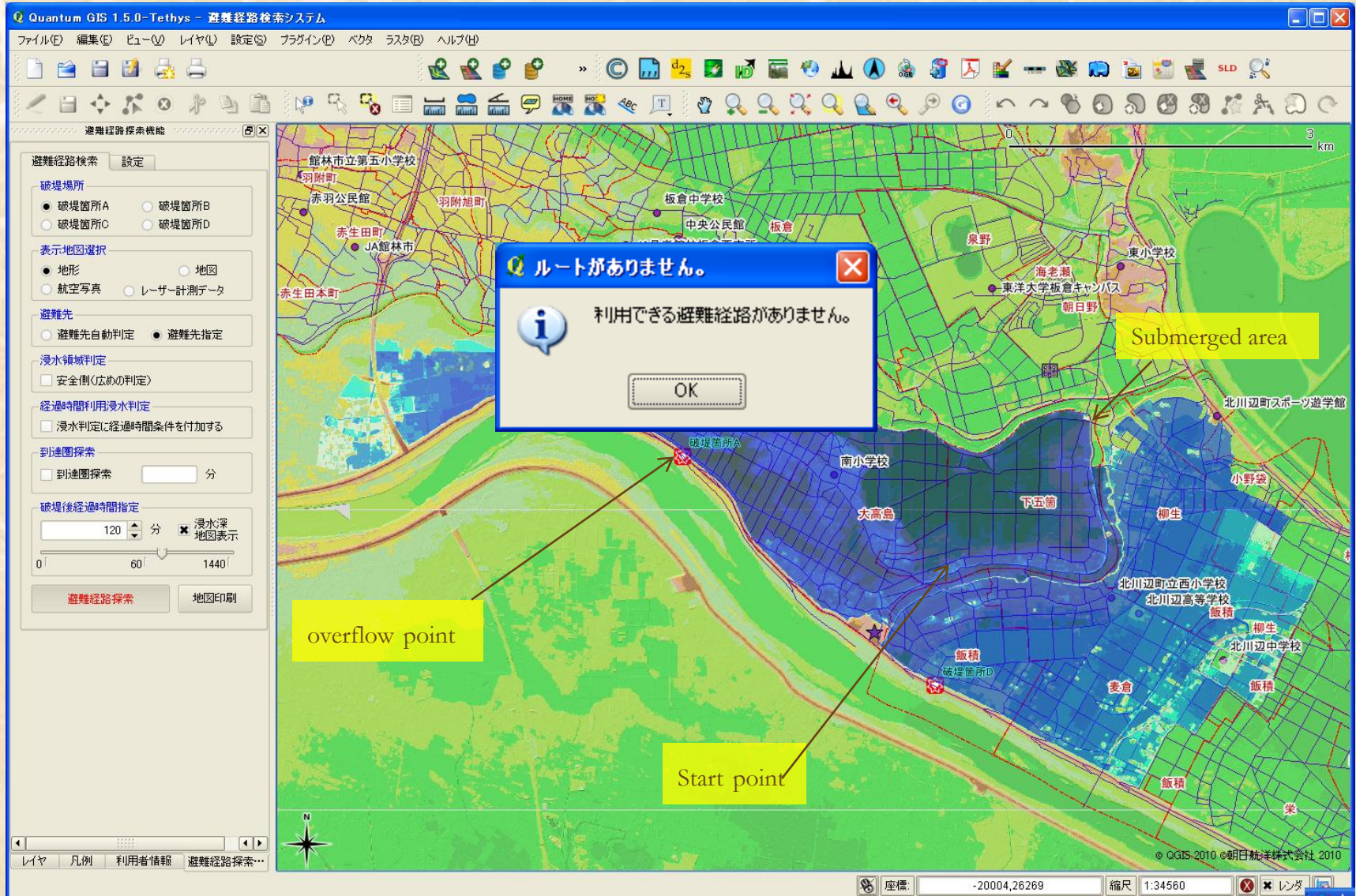
A system using pgRouting



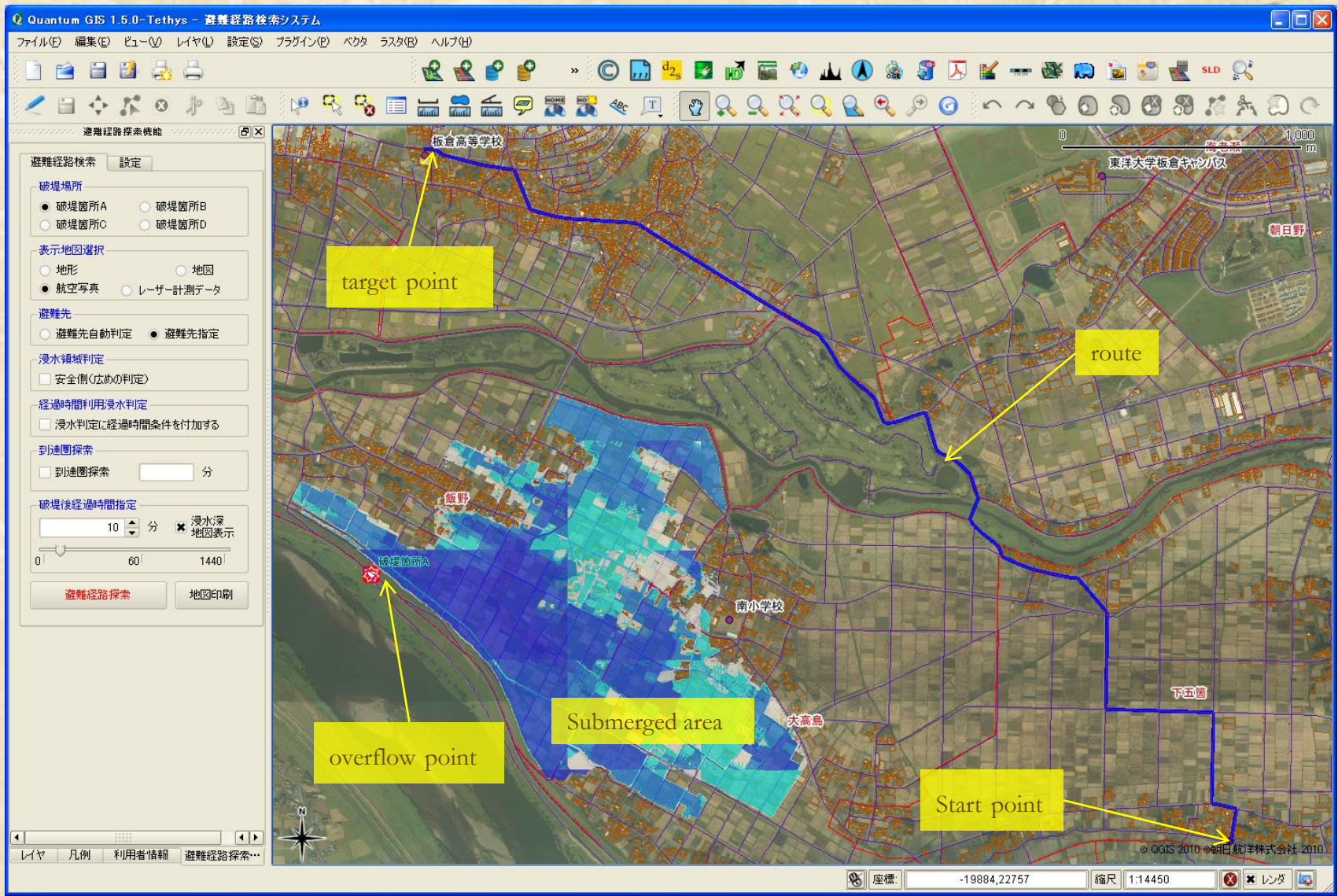
Route to a shelter



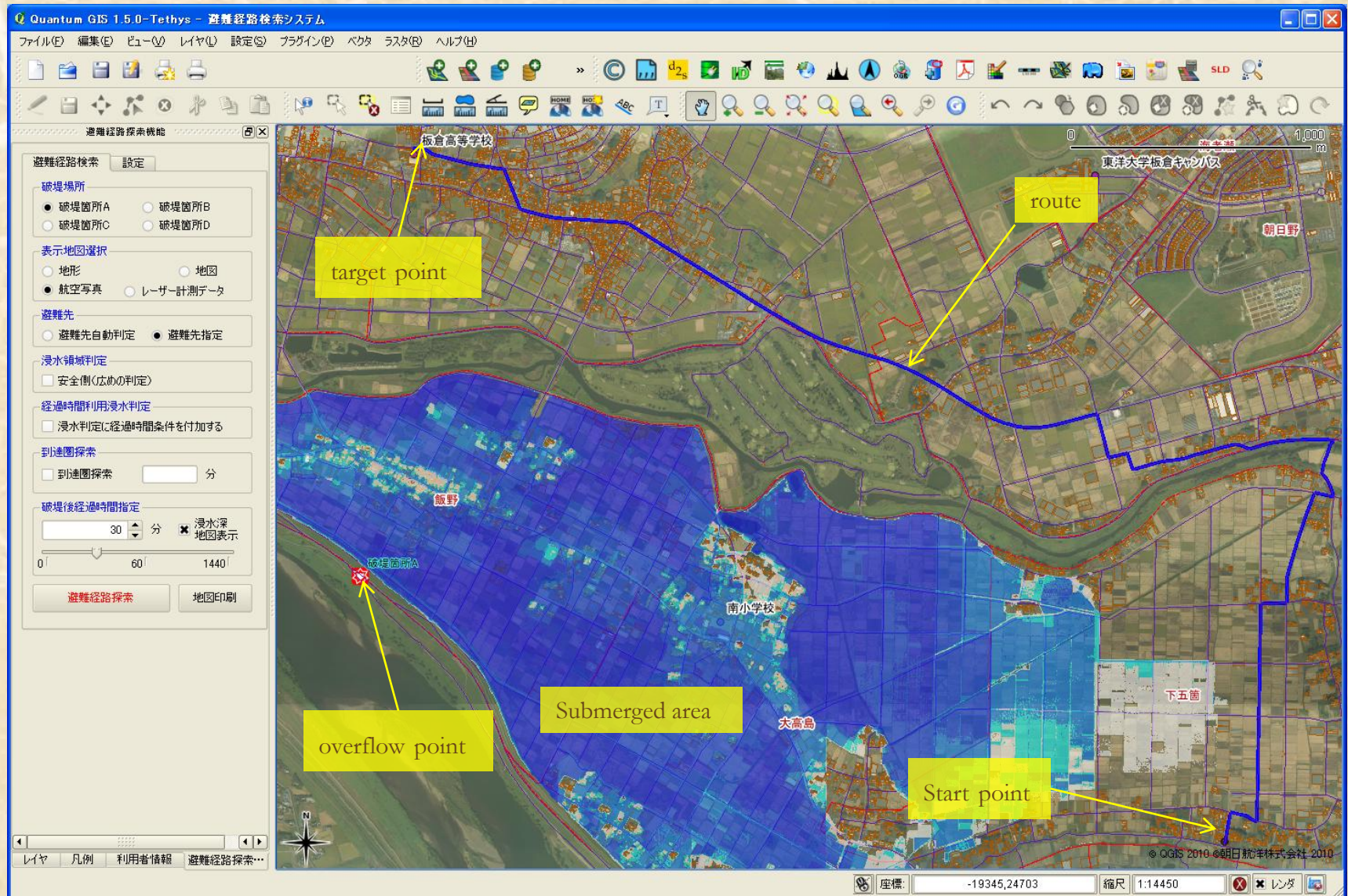
There are no route to any shelter



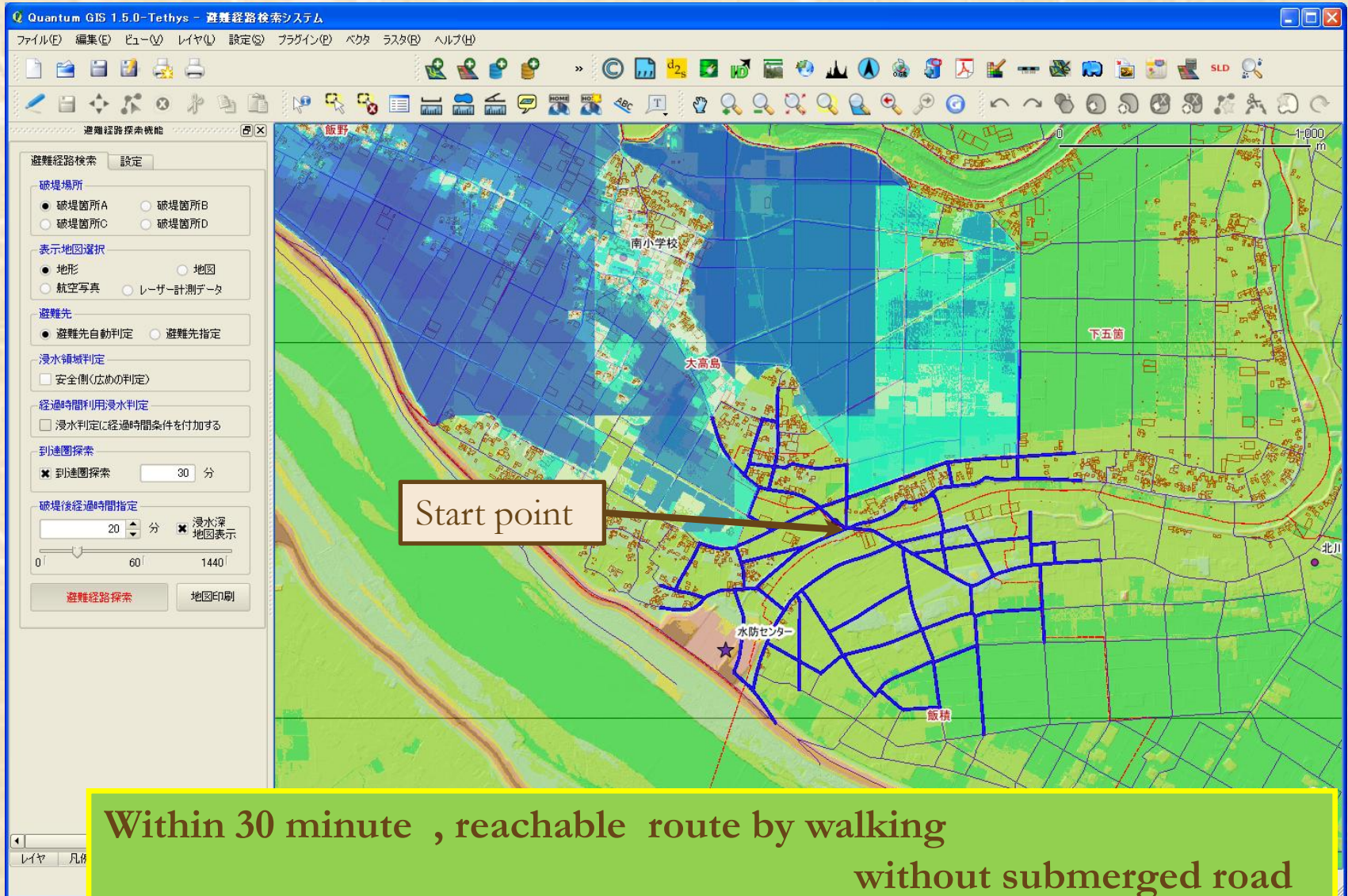
10 minutes later after overflow



30 minutes later after overflow



Driving distance calculation



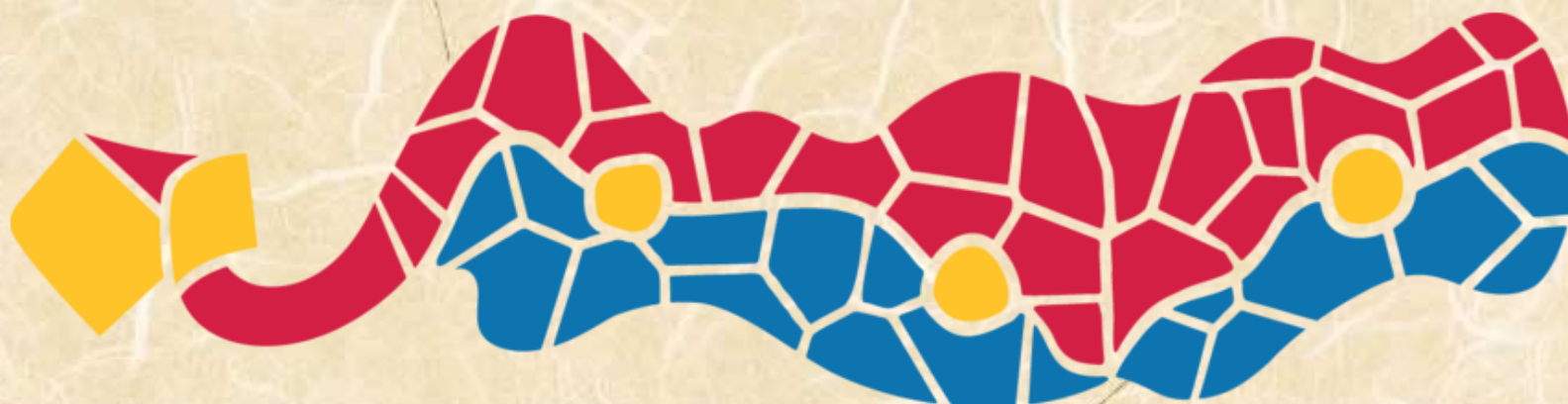
Demo ?

Using FOSS4G products

- Without FOSS4G we would have been difficult to obtain tools for such spatial data usage.
- pgRouting, PostGIS/PostgreSQL, GRASS, QGIS have excellent functions for our works.
- I think when we want to use some functions about spatial data, make combination of some FOSS4G product is best solution.

- This system made for The Ministry of Land, Infrastructure, Transport and Tourism Japan, Kanto Regional Development Bureau.

Thanks for your attention



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Monday 6th through Thursday 9 September, 2010