RESEARCH AND DEVELOPMENT OF FLOOD PREDICTION SYSTEM THAT USES ASTER DATA

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ABSTRACT

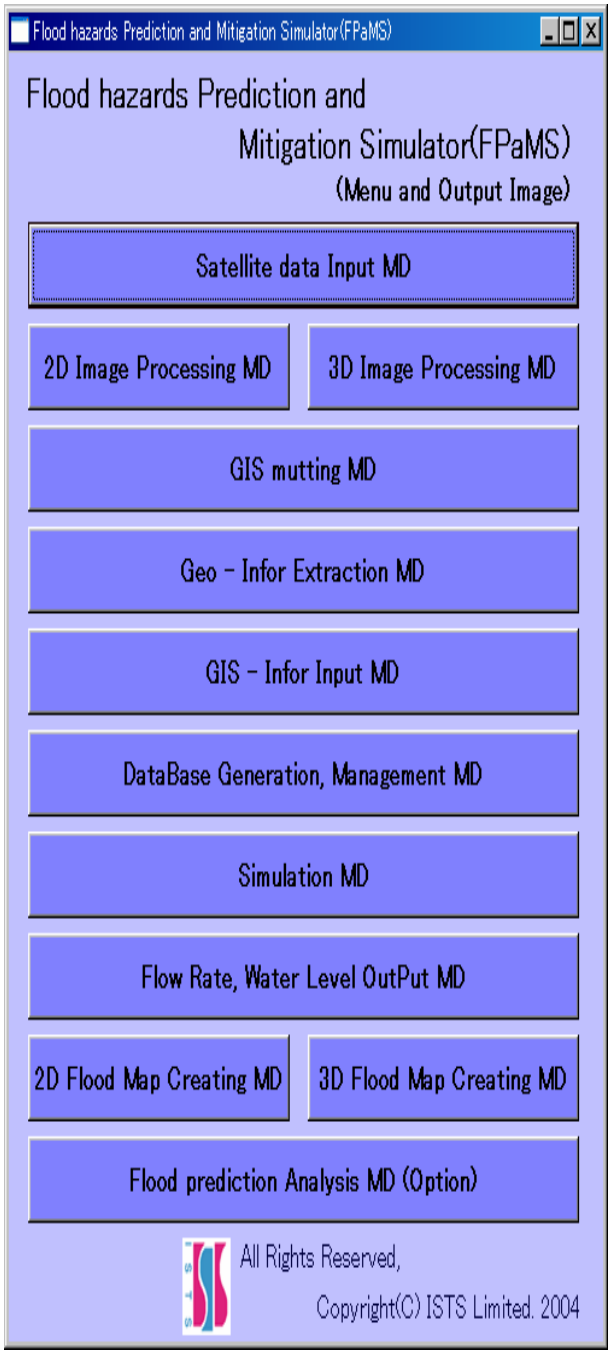
ISTS, Information and Science Techno-System Co., Ltd, has put Research and Development of Flood Prediction System that uses ASTER data in practice. The goal of this Research and Development is to establish Flood Prediction Simulator that uses the Satellite Remote Sensing data.
This report is to introduce extraction of the Topography information and measurement of Geology information from the VNIR (Visible Near-Infrared) data/ASTER. Moreover, Reporting Algorithm for extraction these Information and the Application Soft ware.

1. INTRODUCTION

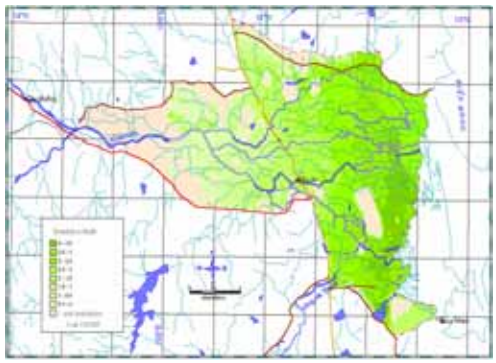
Flood hazards are often occurred at the downriver in Southeast Asian mountains area every year. Humanity and an economical loss are serious problems in this area. Moreover, the maintenance of GIS information is insufficient, environment and correspondence to disaster prevention is late in theses area. To reduce these social problems, the use of the RS data obtained stable accuracy, short a time, low cost is the most effective. In this prediction and development, the extraction and the measurement of geographical features and geological features information are done from the VNIR band data of Terra/ASTER, and the creating input database of the improvement type for flood prediction model (engine). The procedure and the measurement algorithm for these information extractions were established and, the application software (function) was developed and also we will develop hybrid model of flood prediction using VRSAP (VIETNAM) and RUNoff block of SWMM (USA).The downriver region in Kon River and Ha-Thanh River of the Binh Dinh ministry in Vietnam was selected to area for research. There are a lot of similar geographical features to Southeast Asia and this area is a frequent occurrence zone of the flood. We received the cooperation (mainly about the data acquisition, the information for verification, and the technical assistance of VRSAP) from MONRE-RSC, RCHAWR of Vietnam, and ERSDAC of Japan.

Fig1 shows the module and output image of flood hazard prediction and mitigation simulator, Fig2 shows the basic function for feature extraction.

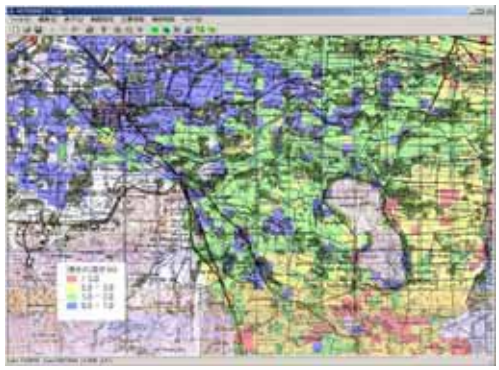
SIMULATOR



Flood Area and water level



2DGISmap



3DSM

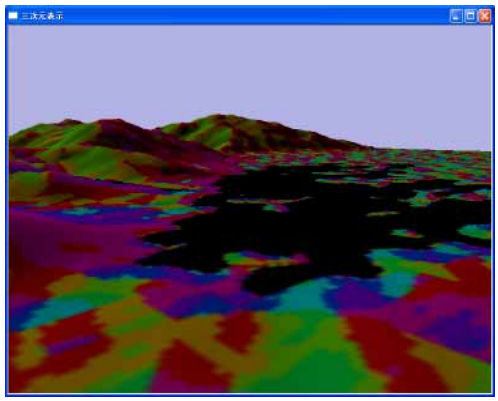


Fig1. The Module and output image of simulator

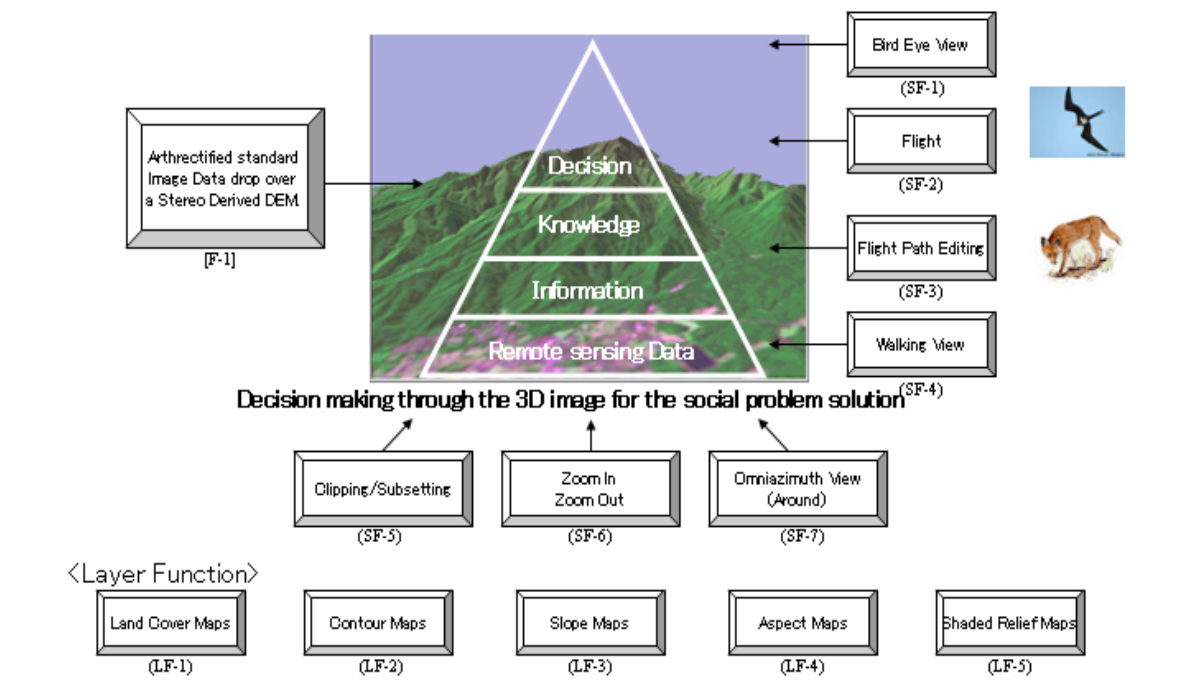


Fig2. the basic function for feature extraction

2. EXTRACTING GEOGRAPHICAL DATA AND FEATURE

Fig3 shows the extraction process of geographical data required for the hybrid flood prediction model.

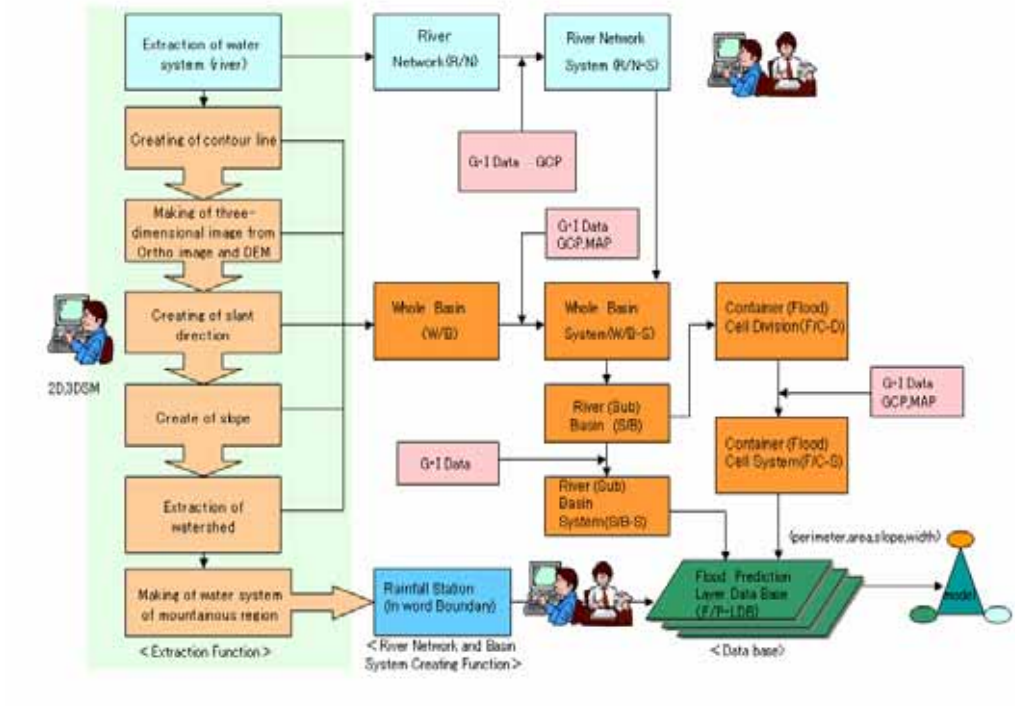


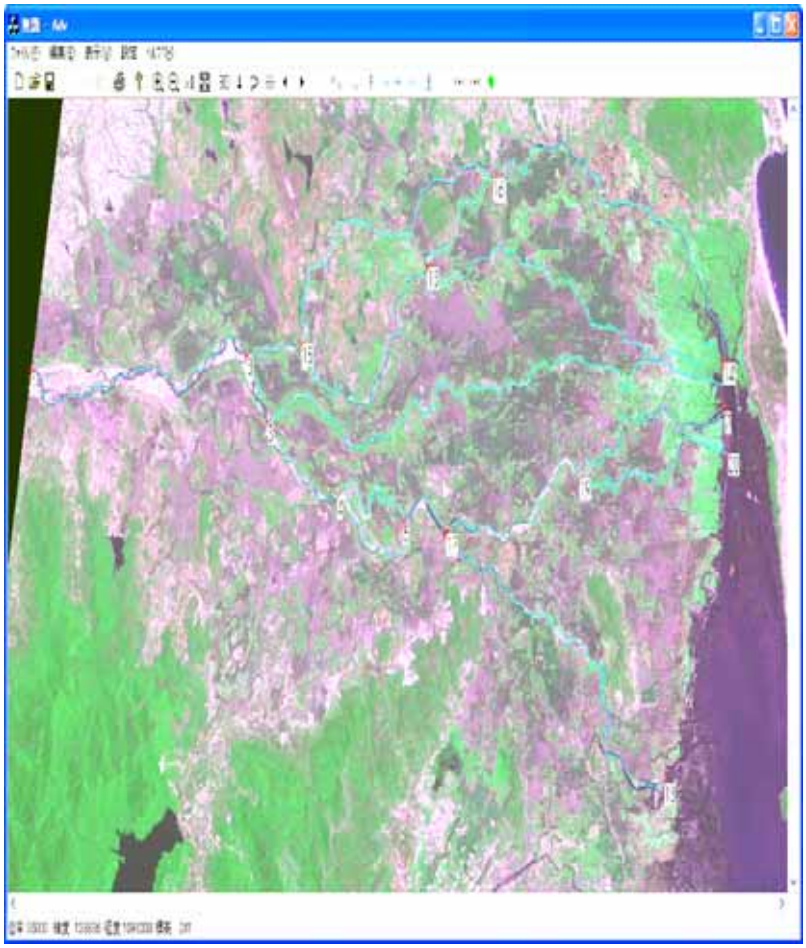
Fig3. The extraction process of geographical data and features

2.1 Extracting river network

The river network is extracted using the grand-water distinction program with the image data composed of BAND1, 2, 3 of VNIR/ASTER.

2.2 Nodes and segments

The extracted river network is now divided with nodes at cross-points of river and some other points meaningful for the flood precognition model. The section from one node to next node is called a segment. The length of segments is calculated automatically. Fig4 shows the extracted river network, its division with nodes, and calculated length of segments.



Segment No	Length
1- 2	11230.1
2- 3	1910.3
3- 4	3952.3
4- 5	4439.5
5- 6	2461.5
6- 7	16040.1
8- 9	2484.2
9- 10	8774.4
10- 11	4638.3
11- 12	14641.6
13- 14	15643.4
15- 16	12517.2
17- 18	14053.2
19- 20	9123.7

Fig4. The river network divided with nodes and calculated length of segments

2.3 Whole basin

To make the whole basin of Binh Dinh ministry, the watershed is extracted from the 3DSM image. This is also called the Boundary of the Basin.

2.4 Sub-basins

Two different main sub-basins, Kon River Basin and Ha Thanh River Basin are made on the whole basin. For each branch flowing into the two rivers, a subcatchment is made on the main sub-basin. Each subcatchment has one rainfall station according to the position of the subcatchment, and has only drainage connected node. Some geographical features of subcatchment (for example, area, slope, perimeter length) are calculated automatically for 2D, 3D images. Fig5 shows the watershed (boundary of the basin) and some subcatchments.

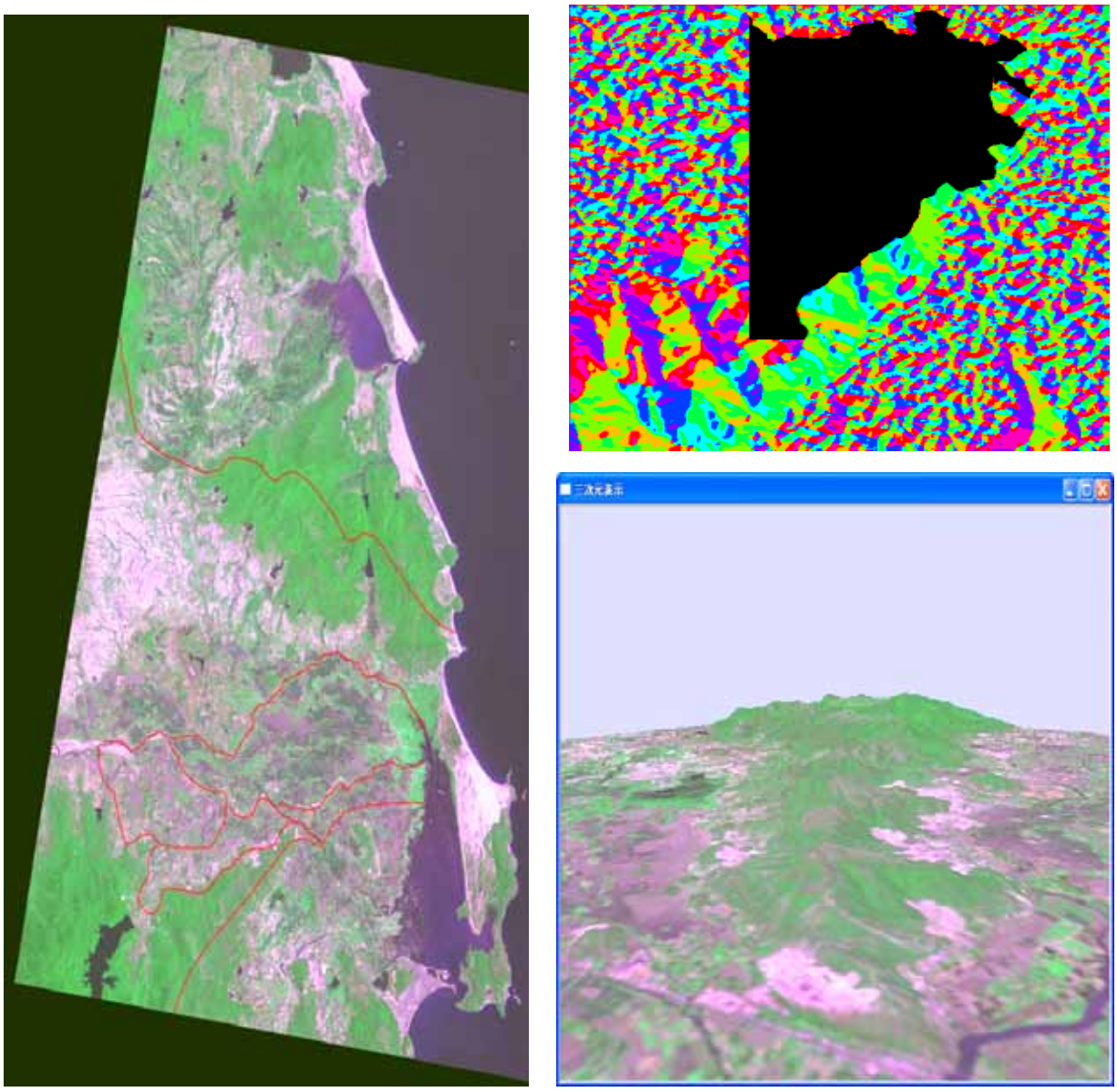
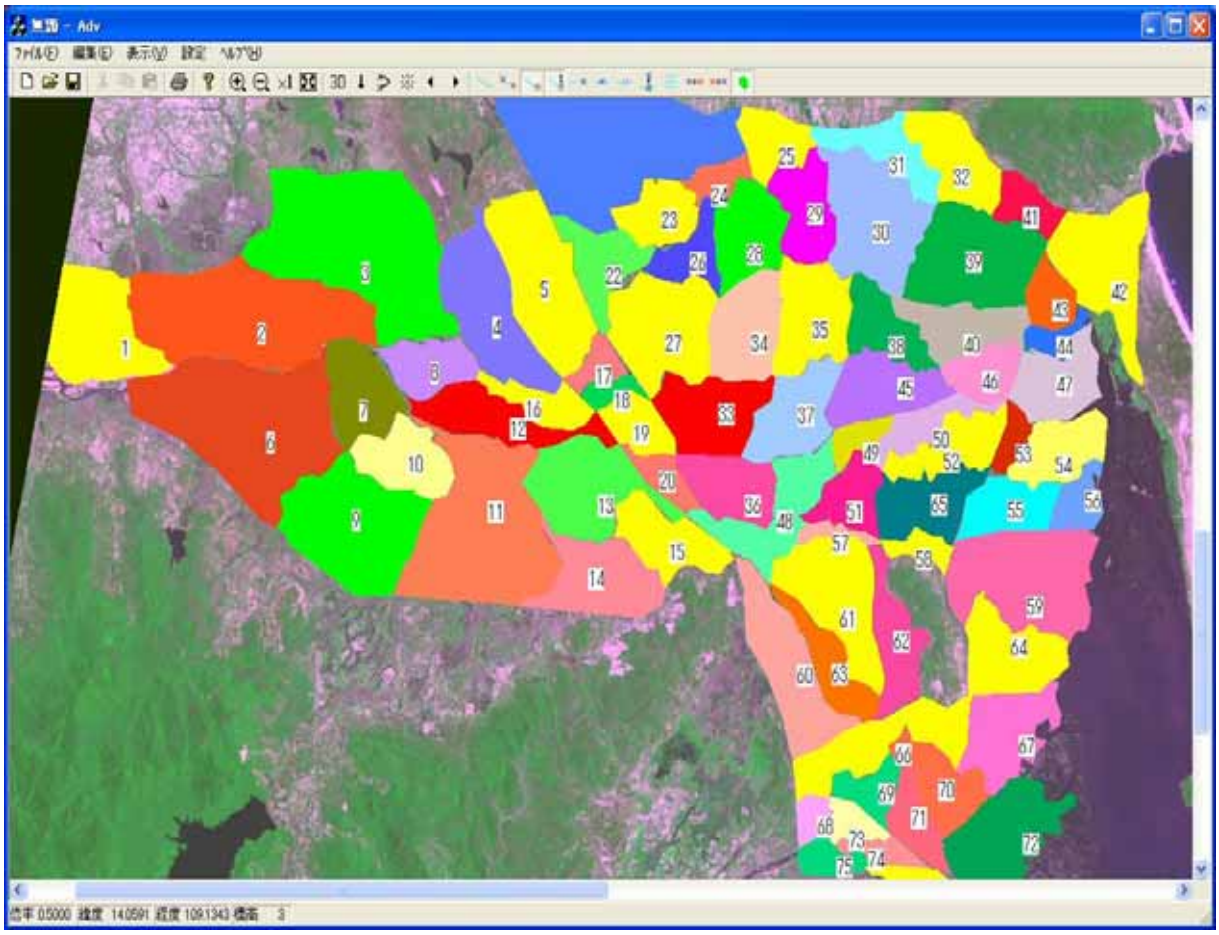


Fig5. The boundary of the basin and some subcatchments (left), image in process of extraction (right-above), and 3D-view of one location (right-below)

2.5 Flood cells

Dividing overflow Plain and field into many close area (call generally as container cell) based on the homogeneity of topographic, geologic condition, traffic ways, field edge an urban residential area using topographic map sheets, GIS and 2D, 3DSM image. As same as in case of subcatchments, some geographical features of cells (for example, area, perimeter length) are calculated automatically for 2D, 3D images. Fig6 shows the divided cells and calculated geographical features.



cell	latitude(deg)	longitude(deg)	height(m)	area(m2)	perimeter(m)	slope(deg)
1	14.0048	108.9654	-1	6909525	11576.1	1.323
2	14.0082	109.0026	0	13857075	18511.5	0.816
3	14.0221	109.0308	-8	16635150	19542.6	0.986
4	14.0097	109.0667	-4	7311600	13320.8	2.219
5	14.0183	109.0798	-5	8181225	13077.9	0.359

Fig6. The divided cells and calculated geographical features.

3. MEASURING GEOLOGICAL DATA AND FEATURES

To calculate the effective rainfall, each subcatchment surface is divided in two areas: impervious and pervious parts. For this operation, the geological pattern map is made. Fig7 shows its measuring process.

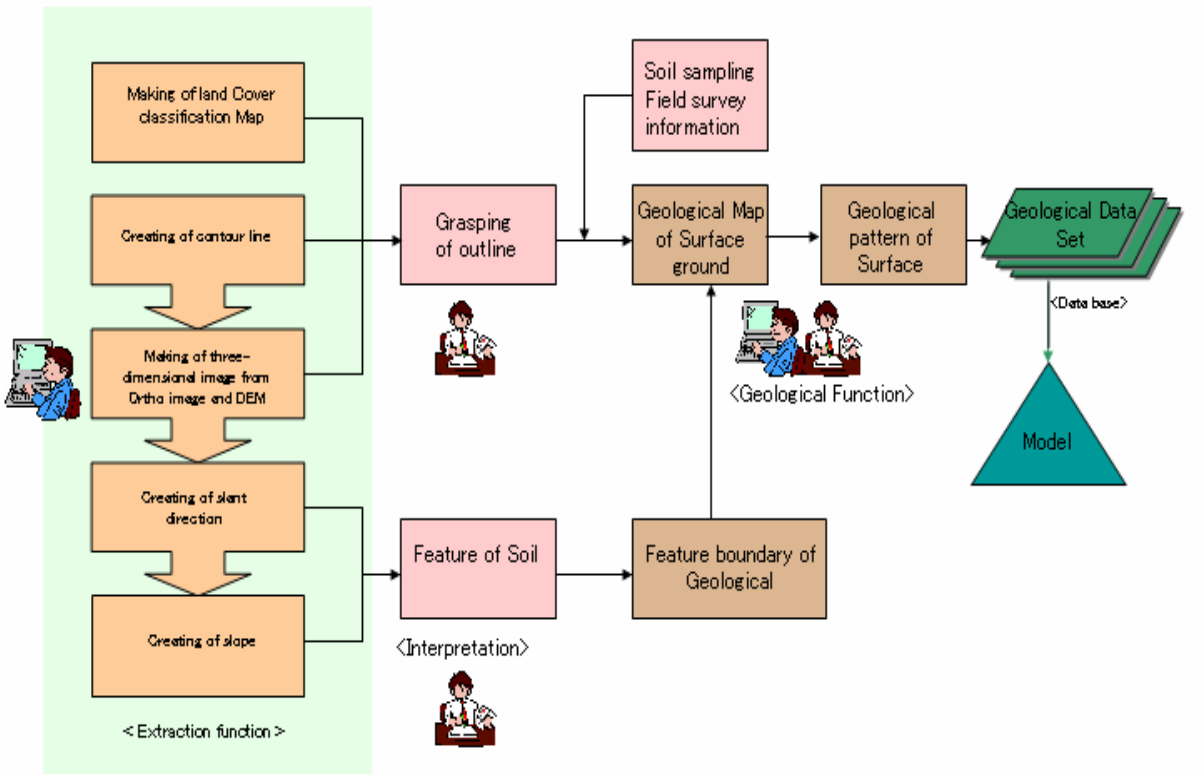


Fig7. The process of measuring geological Data and features

3.1 Geological pattern map

The geological pattern map is made referring 3DSM, land-cover classification map and some data of the fieldwork. Fig8 shows the land-cover map and the geological pattern map.

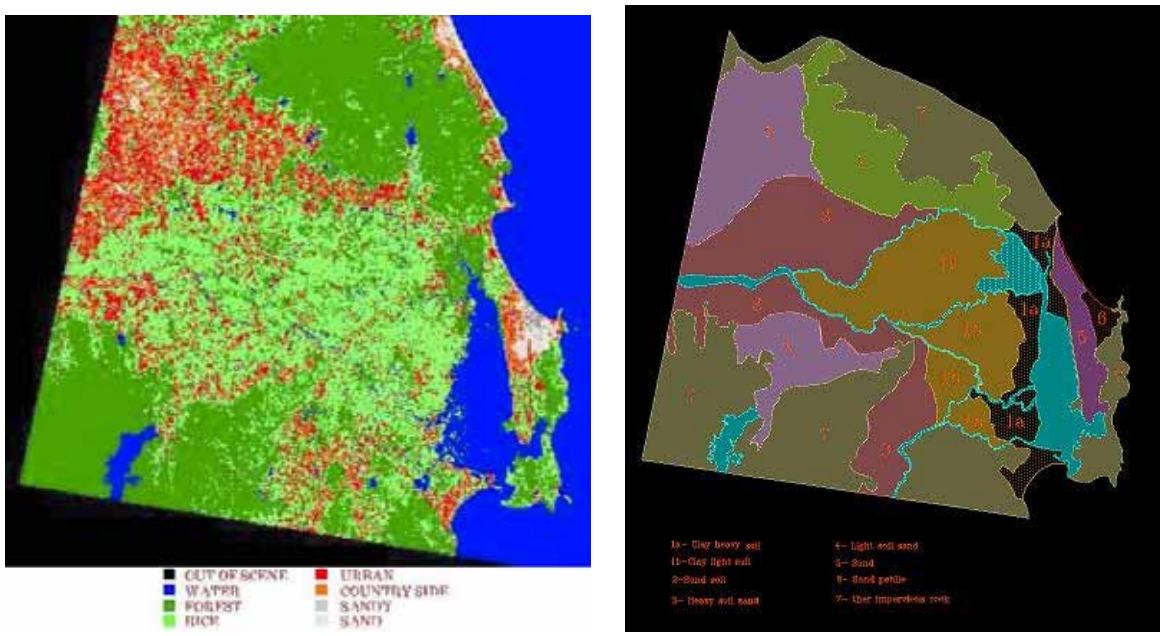


Fig8. The land-cover map and the geological pattern map

4. APPLICATION SOFTWARE

4.1 Geographical and geological data extraction software

We developed a program that makes the river network, sub-basins, segments (using nodes), watershed, whole basin, sub basin and cells semi-automatically or automatically and extracts geographical data automatically and we developed the geological pattern map software on the land-cover map using information of the fieldwork.

4.2 Flood map generation software

We developed flood map generation software (FL-MAP^2). This software use to display result of the simulator and this software includes some effective/useful function. Fig9 shows main function, sub function, basic function of the FL-MAP^2

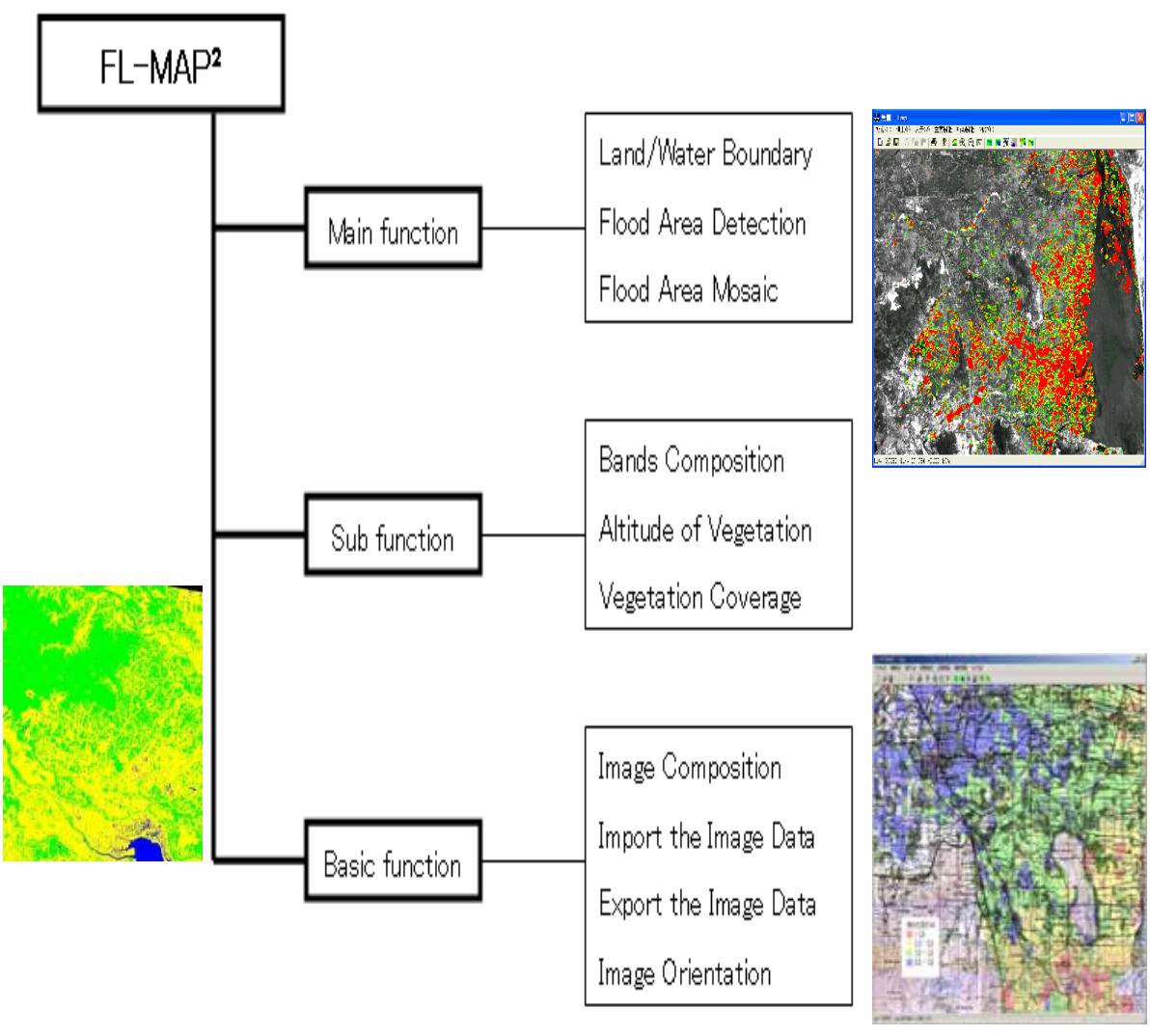


Fig9. Functions of the FL-MAP^2

5. CONCLUSION

5.1 Extraction of Geographical/Geological data and features

As described here, our development now reaches many results. Our program performs the following functions automatically or semi-automatically.

- Extracting river network. (semi-automatically)
- Extracting watershed. (automatically)
- Creating sub-basin. (semi-automatically)
- Measuring length of segments. (automatically)
- Measuring some geographical data of sub-basins. (automatically)
- Measuring some geographical data of cells. (automatically)

But some other data required in the hybrid flood prediction model (for example, horizontal cross-section area for each 0.25m height) are measured by fieldworks, for problems of the accuracy. In fact, the geological pattern map needs both of remote sensing data and fieldwork data, as explained.

5.2 Flood map generation software

This software is used not only the for displaying the result of flood prediction and mitigation simulator but also for many other purposes because including each effective sub-functions and basic functions, BAND images composition, altitude of vegetation, image composition/orientation and image import/export. Especially in some purpose of social problem solution it may show much benefits.

REFERENCES

VRSAP manual.
Wayne C. H. , & Robert E. D. , 1992. *STORM WATER MANAGEMENT MODEL, VERSION 4: USER'S MANUAL.*
ISTS., 2003. *Research and Development of flood prediction System that uses ASTER data.*