Applications of Terra/ASTER data to environmental management and disaster mitigation

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ABSTRACT

ERSDAC, Earth Remote Sensing Data Analysis Center, has conducted research and development aiming at application of Terra/ASTER (Advanced Spatial-borne Thermal Emission and Reflection Radiometer) to the field of natural resources mainly since ERSDAC was established. But since Terra/ASTER was launched, many applications have been developed and many case studies have been conducted not only for natural resources but also for environmental management and disaster mitigation.

In this report, some of the numerous Terra/ASTER applications and case studies of environmental management and disaster mitigation are summarized.

1. INTRODUCTION

ASTER is a moderate resolution sensor developed by the Japanese Ministry of Economy, Trade and Industry (METI), with the aim of obtaining regional detailed geological information and understanding phenomena, possible to render major impacts on the earth's environment.

ASTER was launched in 1999 onboard Terra satellite, which is the first platform comprising constellation planned under NASA-sponsored EOS project.

Since then, ASTER has acquired more than 700,000 scenes so far.

ERSDAC has been engaged in cultivating ASTER data application in wider fields including natural resource exploration, environment and disaster mitigation, as well as verification of the application technique.

As a result, ASTER data proved quite effective in the fields of environment and disaster mitigation with its profound spatial and spectral resolution, as well as stereo function.

Terra/ASTER sensors' main characteristics are as follows;

1) 3 bands in VNIR region with 15m Spatial resolution

2) Acquiring stereoscopic data on a single orbit

3) 6 bands in SWIR region with 30m Spatial resolution

4) 5 bands in TIR region with 90m Spatial resolution which Terra/ASTER is only sensor to load multi bands in this region

In addition to the example of its application in natural resource exploration and development introduced at the last symposium, I would like to show you some examples of its application to environment and disaster prevention this time.

2. Environment management

2.1 Shallow Water and Coastal Environment Monitoring using ASTER data

The aim of the study is to develop a methodology to monitor in the shallow water bottom and coastal environment by using Terra/ASTER data. The coastal area of Abu Dhabi of United Arab Emirates is targeted in the study.

For this purpose, bottom types of shallow water area (<5m) and vegetation types derived from Terra/ASTER data are investigated. Bottom index (BI) is applied to map bottom type. SAVI (Soil Adjusted Vegetation Index) is applied to extract vegetation area and supervised classification is applied to map vegetation types.

$$BI=\ln(r1)-(k_1/k_2) * \ln(r2) \quad (1)$$

where r1, r2 are reflectance of Terra/ASTER band1 and band2 respectively and k1, k2 are extinction coefficients of ASTER band1 and band2, respectively.

$$SAVI=(1+L) * (NIR-R)/(NIR+R+L) \quad (2)$$

where L soil adjusted index (in this study, 0.5 is adopted), NIR and R reflectance of Terra/ASTER band 3 and band2, respectively.

Map of bottom type and vegetation type were developed to investigate the relationship between calculated bottom index and actual bottom types, as well as calculated vegetation types and actual vegetation types.

Bottom index value of 2.5 was found to discriminate sea grass and seaweed from sand bottom and/or coral (Fig.1).

The result of supervised classification showed the discriminability of vegetation types including mangroves, halophytes (except mangrove) and algal mat (Figure.1).

By using these maps derived from multi temporal Terra/ASTER data, it will be possible to monitor the environmental change.

2.2 Water Quality Monitoring

The aim of this study is to develop a methodology of two-dimensional water quality monitoring. Only spotted data have been applied to the water quality analysis so far.

Kasumigaura lake in Japan was chosen as a targeted area of project.

To investigate the applicability of Terra/ASTER data for water quality monitoring, three parameters i.e. Turbidity, Chlorophyll-a concentration (Chl-a con.) and Water Temperature derived from Terra/ASTER data were compared with real time data.

$$Turbidity=a+b * (Band1-Band3) \quad (3)$$

$$Chl\text{-}a\ Con.=c+d * (Band3-Band2) \quad (4)$$

where a, b, c and d are coefficient derived from recurrent analysis.

Water Temperature is calculated from 5 bands of Terra/ASTER/TIR.

By using these three parameters, it will be possible to analyze water quality two-dimensionally.

The turbidity calculated by formula (3) before and after the mud dredging attests to the fact that the countermeasure for purification of the lake water was efficient (Figure.2).

3 Disaster Mitigation

The aim of the study is to show the effectiveness of using Terra/ASTER data for the hazard map (disaster prevention information map).

For the purpose, disaster prone areas were chosen as follows,

Niigata area: possible to be hit by a severe earthquake

Mt. Aso area: volcanic mountain area

In these areas, important factors extracted from Terra/ASTER data, existing information and field data for the hazard map are examined.

As a result of this examination, it become clear that Terra/ASTER data is very useful to generate user-friendly map, for three reasons ; 1) Terra/ASTER image can be used as the base image of the map, 2) the geomorphologic interpretation results is applicable to wide area subject to disaster prevention, and 3) birds-eye view using Terra/ASTER DEM is very effective to grasp the disaster information intuitively.

4 Conclusion

As a result, Terra/ASTER data proved to be useful for environmental management and effective in extracting various information to be applied to a hazard map, thanks to the superior characteristics of Terra/ASTER listed below:

*Visible near-infrared (VNIR) of three bands with the spatial resolution of 15m and along-track Stereo view capability,

*Short-wave infrared (SWIR) of six bands in the wavelength range of LANDSAT TM/ETM+ band 7

*Thermal infrared (TIR) of five bands initially as a satellite-borne.

5 REFERENCES

ERSDAC, 2004. *Environmental Monitoring Using ASTER Image Data in the United Arab Emirates*

ERSDAC, 2003. *Research and Development on Monitoring Method of Lake Water Quality using ASTER data*

ERSDAC, 2004. *Information Map of Disaster Prevention Using ASTER data*

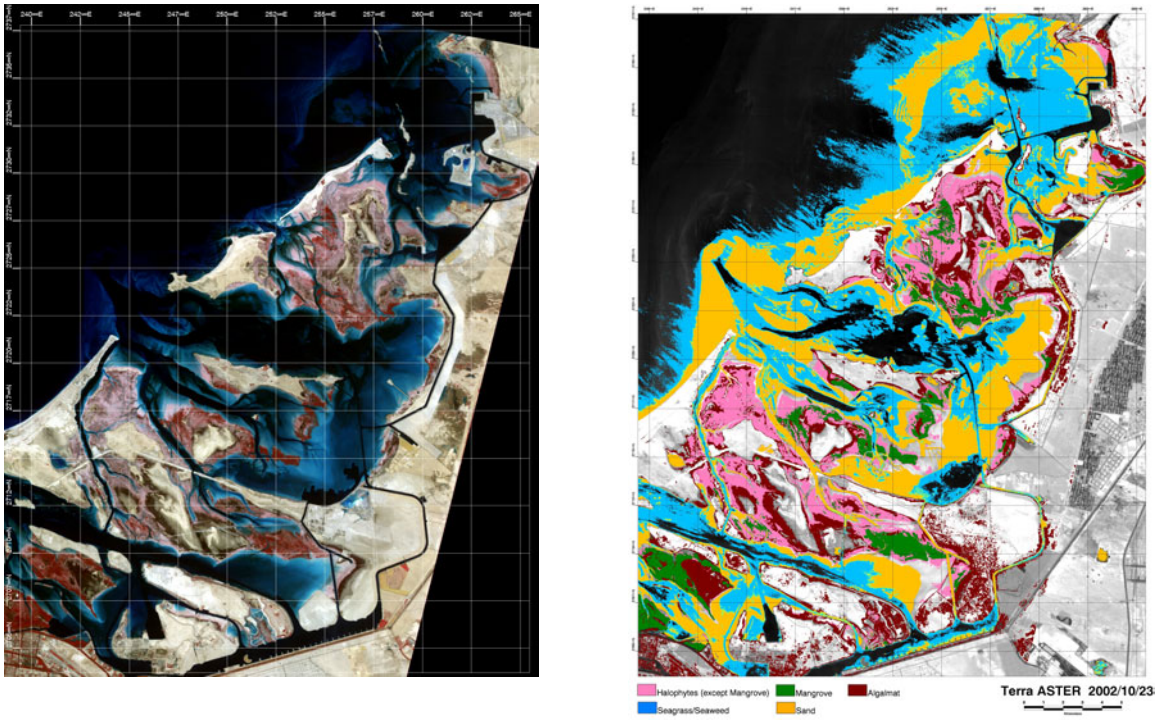

Figure.1 Terra/ASTER original image (RGB=321) and Synthetic display of vegetation types and Bottom types

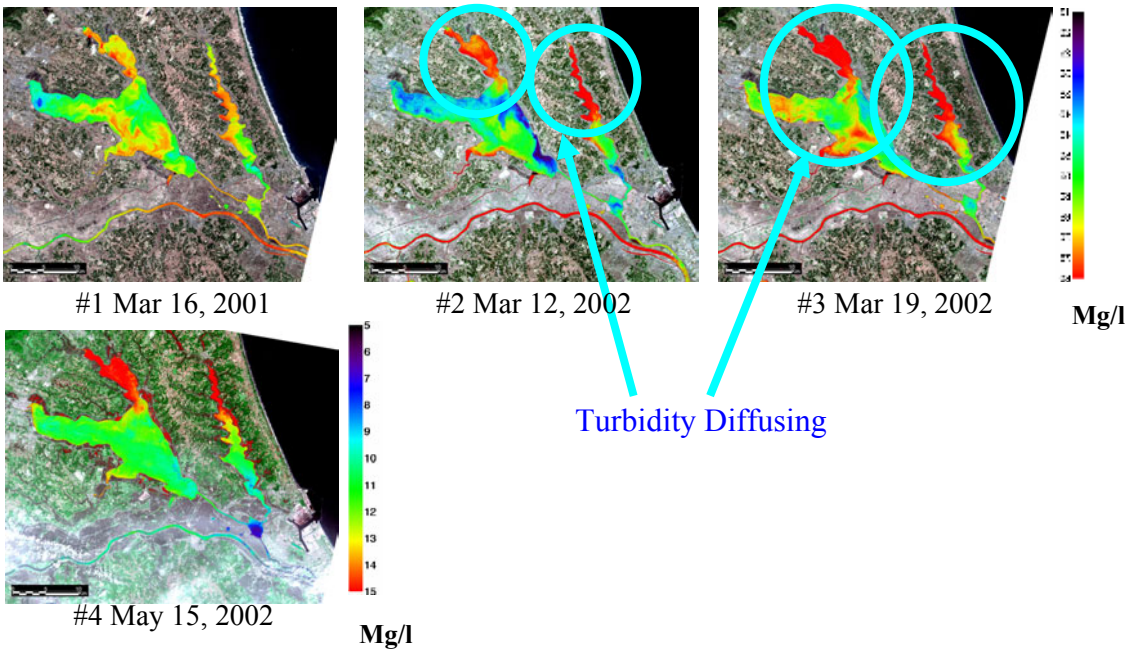

Figure.2 The result of Water Turbidity monitoring

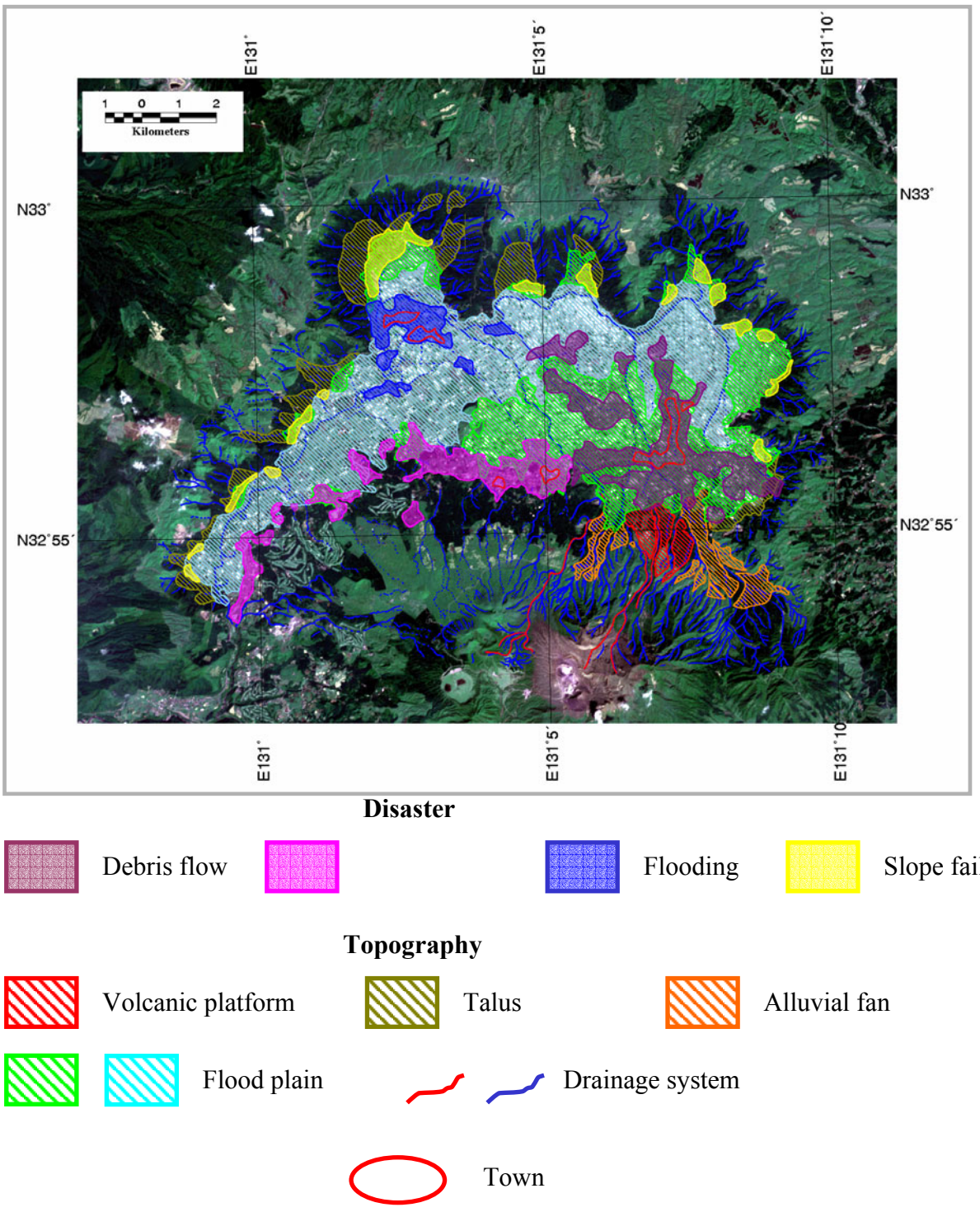

Figure.3 Disaster Information map at Mt. Aso area