TRIC

ENGLISH VERSION

TOKAI UNIVERSITY RESEARCH & INFORMATION CENTER

東海大学情報技術センター

TOKAI UNIVERSITY

TOKAI UNIVERSITY RESEARCH & INFORMATION CENTER
〒151—0063 Tomigaya 2-28-4 Shibuya-ku Tokyo TEL:03-3481-0611 FAX:03-3481-0610 URL:http://www.tric.u-tokai.ac.jp/

TOKAI UNIVERSITY SPACE INFORMATION CENTER
〒861—2205 Sugido 871-12 Mashikimachi Kamimashikigun Kumamoto TEL:03-3481-0611 FAX:03-3481-0610 URL:http://www.tric.u-tokai.ac.jp/

Ahead of the field

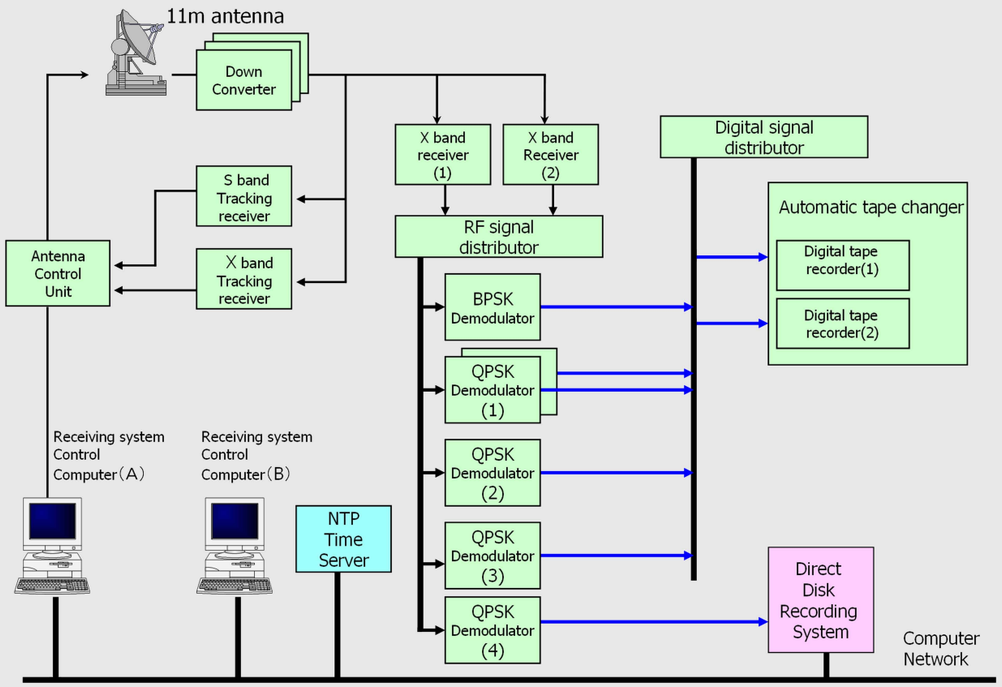
Tokai University intensively promotes Earth observation research utilizing satellite data. The underlying principle of Tokai University's research and education centers on the study of the natural and social sciences. In particular, recent research in the natural sciences concerning the Earth emphasizes the relationship between the Earth and humankind. Believing that we must follow the Earth's history thoroughly from the past into the future, Tokai University established the Tokai University Research & Information Center (TRIC) in 1974 as a part of its plan for comprehensive Earth observation.

During the 35 years since its establishment, TRIC has been engaged in continuous research and study, including R & D in natural sciences, observation of the Earth from outer space as well as data processing and analysis, and TRIC has assumed a leading role in the field of image information engineering. In 1986, we established the Tokai University Space Information Center (TSIC) as an affiliated facility of TRIC. TSIC was the first Earth observation satellite data receiving station in the world to be established as part of a university. The establishment of these two centers was the result of Tokai University's great foresight, which allowed it to predict and prepare for the situation we face today.

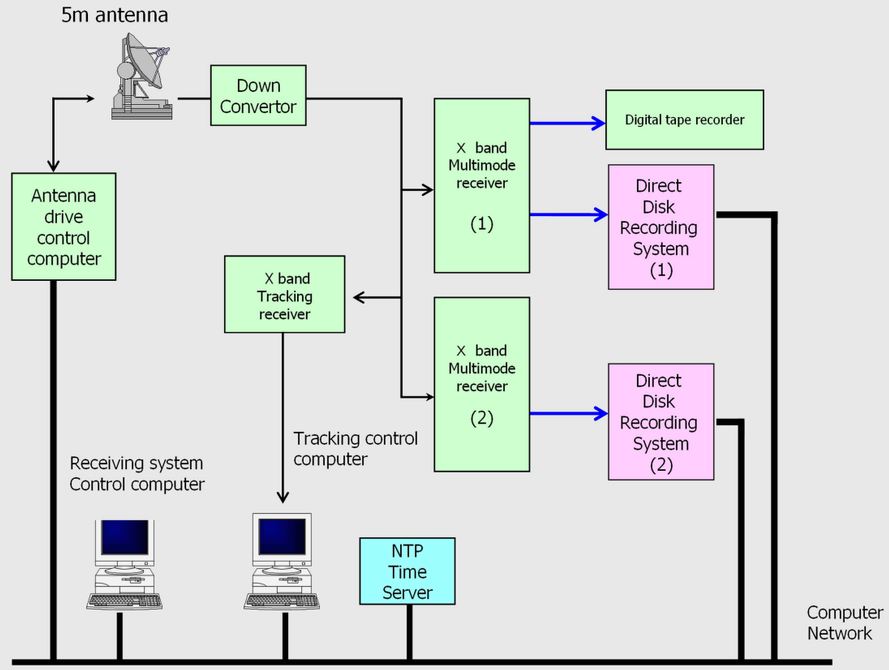
The various results obtained by TRIC and TSIC over more than three decades have grown into a fundamental database that contributes to society and international joint research projects that are now underway. In order to utilize the research data and these experiences in a more interdisciplinary manner and give back to society, we believe that the future mission of Tokai University is to make TRIC and TSIC into leading facilities to elucidate the Earth's natural phenomena.

TSIC Satellite Data Receiving System

■ A block diagram of the 11m antenna satellite data receiving system

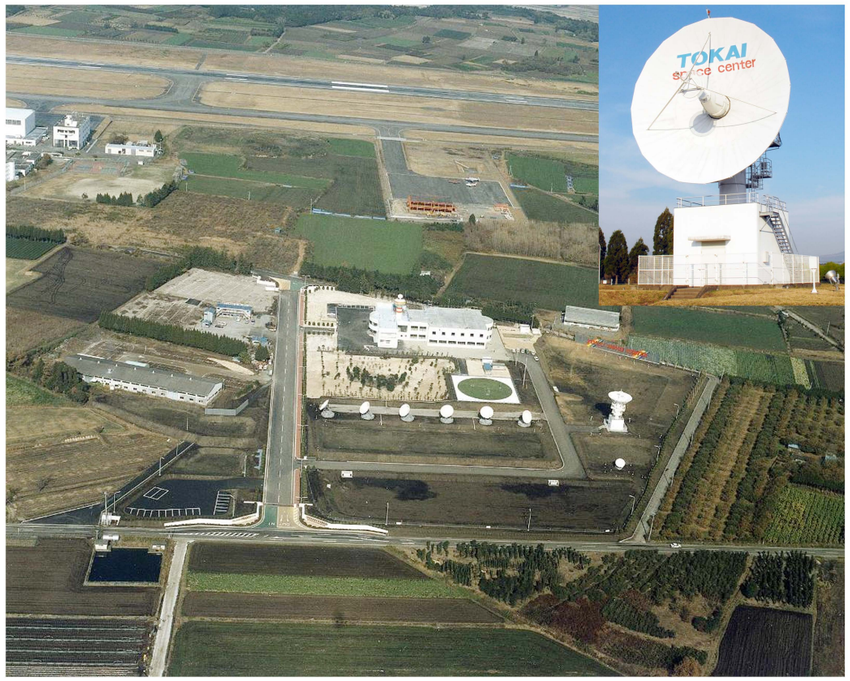


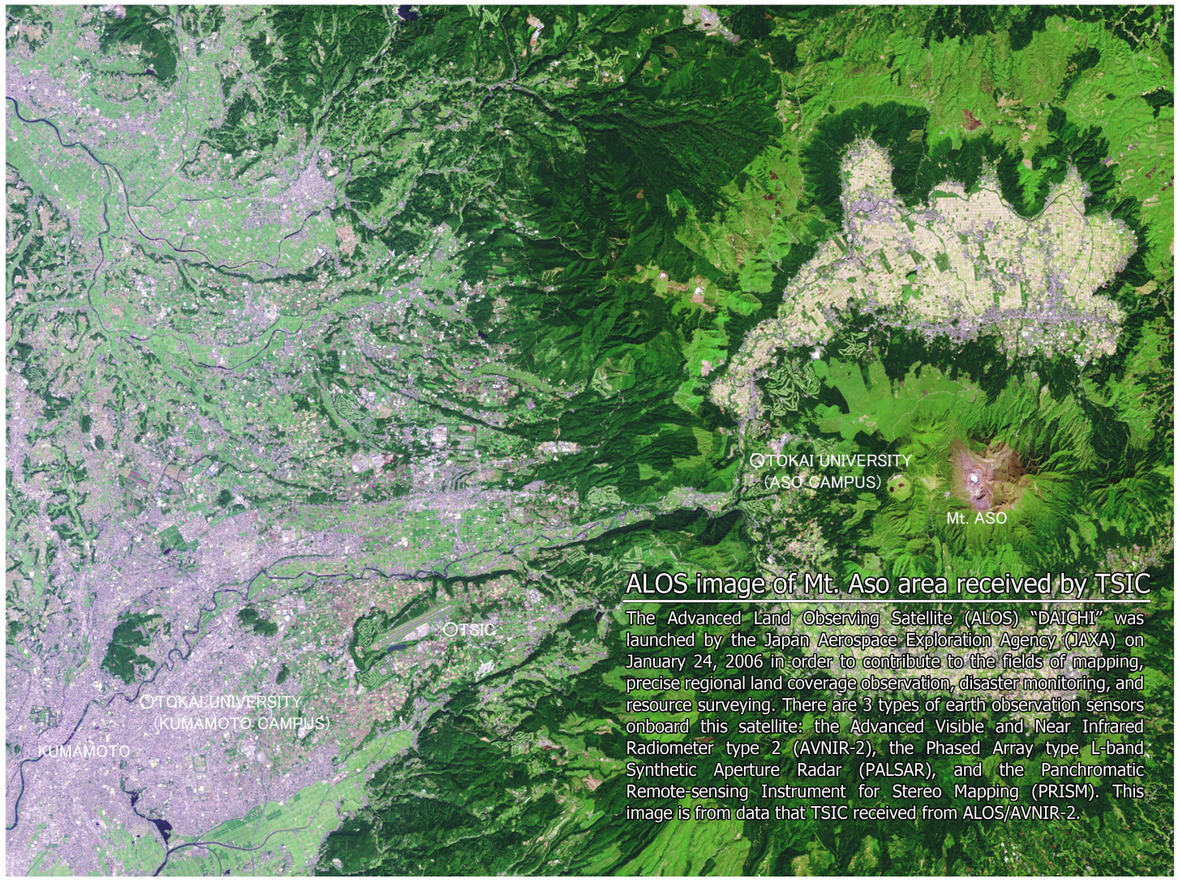
■ A block diagram of the 5m antenna receiving system



■THE SPACE INFORMATION CENTER (TSIC) KUMAMOTO

At TSIC, there are various satellite data receiving antennae, such as the X-Band antenna which has a diameter of 11m. Here, research is done on the receiving, processing, and distribution of earth observation satellite data. After undergoing high-level processing, data received at TSIC is provided to users through the TSIC homepage.





ALOS image of Mt. Aso area received by TSIC

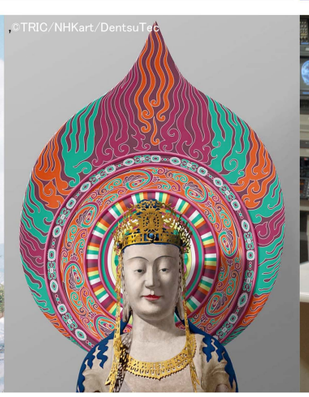
The Advanced Land Observing Satellite (ALOS) "DAICHI" was launched by the Japan Aerospace Exploration Agency (JAXA) on January 24, 2006 in order to contribute to the fields of mapping, precise regional land coverage observation, disaster monitoring, and resource surveying. There are 3 types of earth observation sensors onboard this satellite: the Advanced Visible and Near Infrared Radiometer type 2 (AVNIR-2), the Phased Array type L-band Synthetic Aperture Radar (PALSAR), and the Panchromatic Remote-sensing Instrument for Stereo Mapping (PRISM). This image is from data that TSIC received from ALOS/AVNIR-2.

Data: Receiving Station=JAXA EOC Satellite=ALOS Sensor=AVNIR-2 Date&Time=2006/09/23 11:06 ©JAXA,2006 Distribution RESTEC
Image Processing : TRIC

Achievements of TRIC

1974	TRIC established on the Shonan Campus
	Analog Image Processing System TIAS1000 installed
1975	Photo processing center established on the Isehara Campus
	Oil pollution monitoring off the coast of Mizushima
1976	R271 Project
1977	Digital Image Processing System TIAS2000 installed
	Started development of the image processing software TIPE
	Sagami River Basin Project
	1st Taisha Bay remote sensing survey (in normal conditions)
1978	Environmental monitoring for all campuses of Tokai University
1979	2nd Taisha Bay remote sensing survey (in flood conditions)
	Environmental monitoring of Lake Furen
1980	Water quality monitoring of Lake Balaton, Hungary
	Surface erosion monitoring of the Kamakura Buddha statue
1981	TRIC headquarters moved to the Yoyogi Campus
	Exploration of uranium ore using satellite data in Mali
	Sendai Project
	Water quality monitoring of Lake Kasumigaura
	Completed the first Landsat digital mosaic image of Japan
1982	Land cover monitoring of Osaka
	Analysis for a damaged mural painting of Senbon-enmado
1983	Land cover monitoring of the Tsurumi River Basin
	A study for landslide detection using satellite data
	A study for city landscape simulation
1984	Assisted in image prosessing for "The 21st Century Warned."
	"Computer Imaging" published
	"Landsat Map" published
	Development of an advanced hydraulic coal mining system
	Assisted in the production of the movie "Godzilla"
	Produced the first-ever satellite movie of the rotating Earth
1985	A TV program "The World Weather" relayed live from TRIC
	Produced a semi real time satellite movie of the rotating Earth
	Development of the first satellite globe of the world
	Land cover monitoring of Shimane Prefecture
1986	Satellite monitoring of Chernobyl nuclear power plant accident
	Image analysis of JAL aircraft accident
	Volcanic eruption monitoring of Izu Ohshima
	Produced a high definition satellite movie of the rotating Earth
1987	Assisted in image processing for "NHK The Miracle Planet"
	Started forest change monitoring of Kumamoto Prefecture
1988	Sarcophagus monitoring of Fujinoki burial mound
	Environment monitoring of Lake Inawashiro
	Land cover monitoring of Yokohama City
	Satellite monitoring of Kola peninsula, USSR
1989	Started Gurvan-Gol Project, Mongolia
	Management of Earth Experience Pavilion, Yokohama Expo
	Assisted in image processing for "NTV Ultra Quiz"
	Mural painting analysis of Horyuji temple
1990	Archaeological investigation of Palmyra, Syria
	Satellite monitoring of Novaya Zemlya, Russia
1991	Planning the Hobetsu Earth Experience Pavilion
	Satellite monitoring of the Gulf War
	Volcanic eruption monitoring of Mt. Pinatubo, the Philippines
	Volcanic eruption monitoring of Mt. Unzen-Fugendake
1992	Mural painting analysis of Takamatsuzuka burial mound
	Archaeological investigation of Kamiyodo-haiji temple
	Started ocean current monitoring using drifted buoy
1993	X-ray image analysis of ancient swords of Fujinoki burial mound
	Automatic satellite data mass storage system installed
1994	Paleoenvironment investigation of Khorezm area, Uzbekistan
	Produced a high definition cloud movie using satellite data
1995	Started pyramid exploration using satellite data
	Investigation of the Great Hanshin earthquake
1996	Satellite map of the Silk Road published
	Dr. Baker, Administrator of NOAA visited TRIC
	TRIC & NASDA started cooperation research programs
	Discovery of the ancient Egyptian remains "Dahshur North"
	Reproduction of ancient Izumo
1997	Environmental study of Xinjiang Uyghur Autonomous Region
	Paleoenvironment investigation of the Nile basin
	Assumptive restoration of the Kudara Kannon statue
1998	Assisted in image processing for "NHK Good Morning Earth"
	Video image analysis of Kitora burial mound
	Paleoenvironment investigation of Tushka, Egypt
1999	HDTV image processing from Space shuttle STS-95
	Assisted in image processing for "NHK satellite View"
	A study for Silk Roadology in Qinghai province
	Assisted in a NHK live TV broadcast from the Grand Canyon
	Assisted in the development of the software "Green Map"
2000	Technical support for STS-99 using HDTV
	Assisted in the production of "NHK The Four Great Civilizations"
	Paleoenvironment investigation of eastern Asia
	Valk antique world and celestial globes reproduced
	Deciphering of mural massages from atomic bomb survivors
2001	Production of sports ball satellite image globes
	Assisted in satellite data processing for Geo-Cosmos, Miraikan
	Leonids observation
2002	Started satellite image processing for a broadband TV
	Development of a low luminance observation system
	A low cost HRPT satellite data receiving system developed
	Assisted in image processing for "NHK The Khotan River"
	Image production for the Yokohama Eurasian Museum
2003	Assisted in image processing for "NHK Data Map"
	New globes of the Moon and Mars produced
2004	Produced a large globe for the Aichi Expo
	Investigation of the Silk Road in Sichuan Province, China
	Assisted in image processing for "NHK The New Silk Road"
2005	Assisted in 3D image processing for "The Story of A Road"
	Assisted in image processing for "NHK The World Heritage"
	Assisted in data processing for "The Great Mountains of Japan"
	Research on archaeological investigations using satellite SAR
	Satellite image analysis of the Great Indian Ocean Tsunami
2006	TRIC and Miraikan concluded a cooperation research agreement
	Development of high definition satellite image movie programs
2007	Development of a 4K image processing module started
2008	Produced a Kaguya Moon globe and a MGS Mars globe
	Dr. Ayman, Chairman of NARSS, Egypt visited TRIC
	Cooperation research programs with Gakushuin Univ. started
2009	Development of 4K digital cinema programs
	Began a new program-Delivery Lecture: "A Story of the Earth"
	A study of the mausoleum of Emperor Qin Shi Huang started
	Cooperation research programs with the Kashikoken started

Ground Truth（1974）



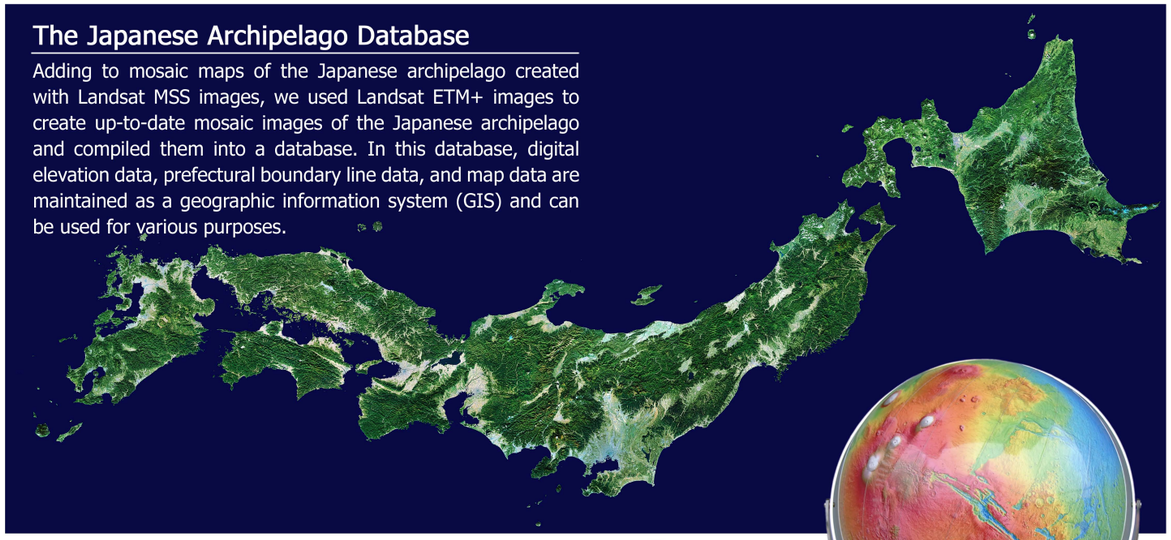
Assumptive Restoration of the Kudara Kannon Statue (1997)

4K Super High Definition Image Processing (2009)

■Applied Research in Image Information

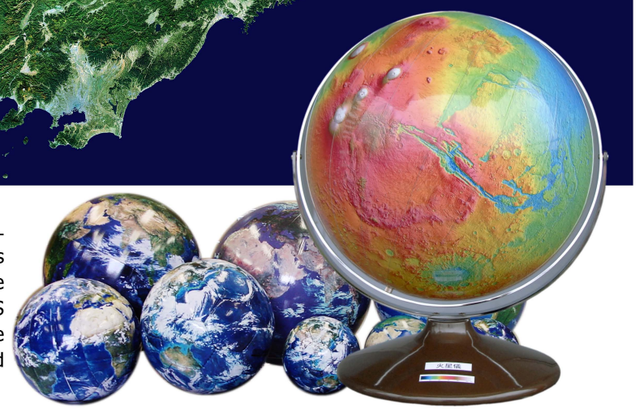
The Japanese Archipelago Database

Adding to mosaic maps of the Japanese archipelago created with Landsat MSS images, we used Landsat ETM+ images to create up-to-date mosaic images of the Japanese archipelago and compiled them into a database. In this database, digital elevation data, prefectural boundary line data, and map data are maintained as a geographic information system (GIS) and can be used for various purposes.



The Development of Educational Products

At TRIC, we are working to develop educational products which use satellite data. Some examples of our products are soccer ball and volleyball-shaped world globes, a MODIS world globe that is one 10-billionth actual size, a globe made with nighttime satellite data, and the trial production and development of a globe of Mars.



■Earth Science Technology Educational Activities

出前講座
地球の物語
A STORY OF THE EARTH

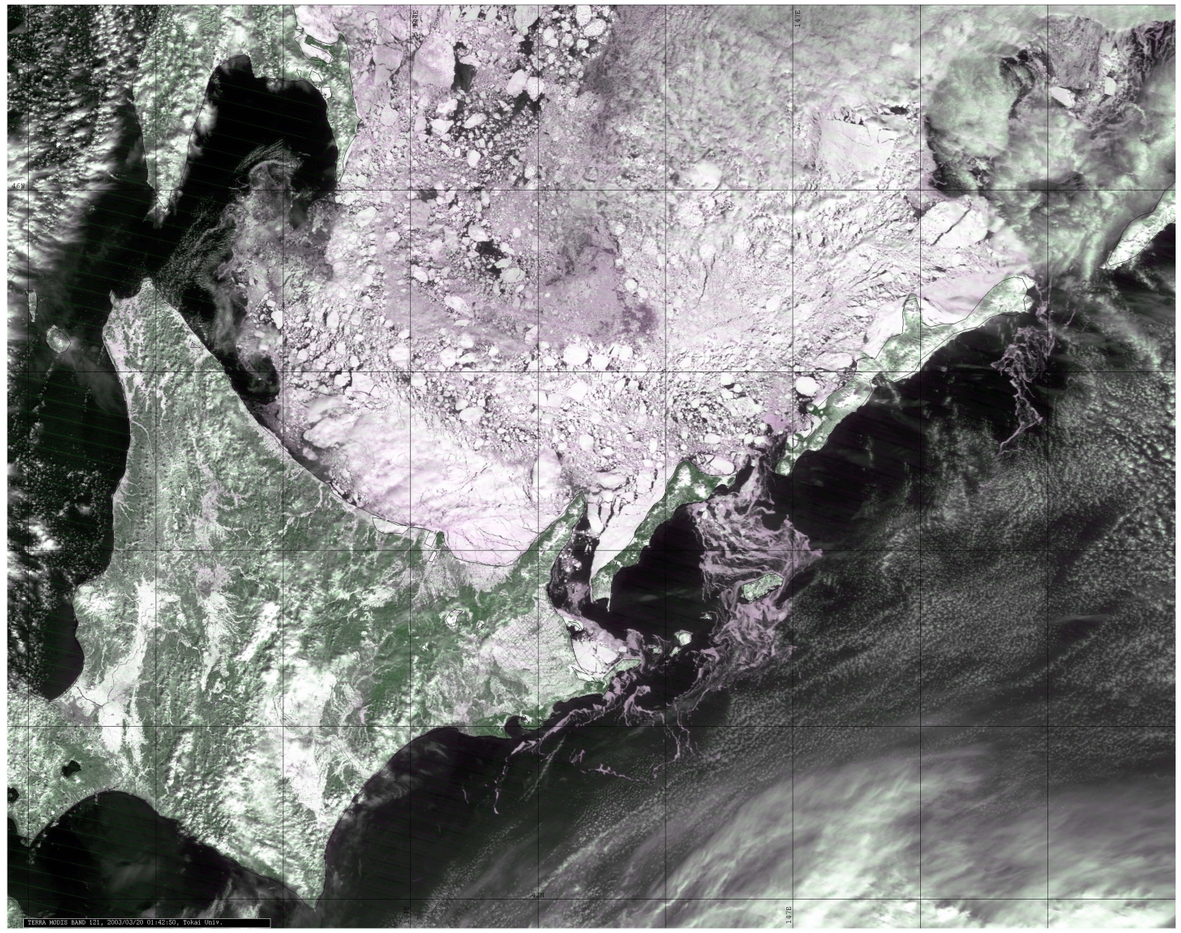
Delivery Lecture: "A Story of the Earth" ～*Helping children to observe and think about the Earth*

At TRIC, we have a special program targeted towards youth. We send expert lecturers on "delivery lectures" anywhere in the country to explain in easy-to-understand terms about the Earth's history and environment using satellite images.

※TRIC assumes responsibility for the cost of dispatching lecturers. Those sponsoring a lecture must provide a lecture venue and gather participants.

Schools and other groups interested in having a Delivery Lecture can contact us at the following;

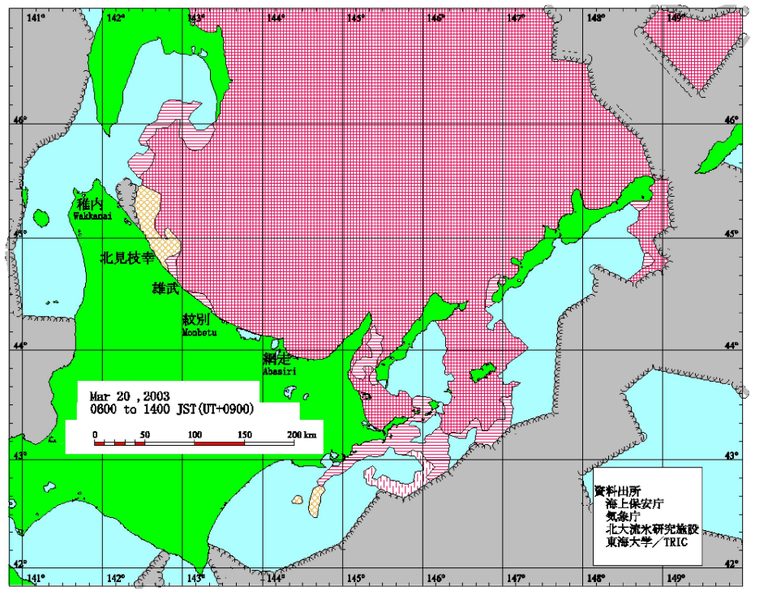
TRIC Delivery Lecture
TEL:03-3481-0611 FAX:03-3481-0610
e-mail : tric@yoyogi.ycc.u-tokai.ac.jp



■Near real time monitoring of sea ice in the Sea of Okhotsk with MODIS

The upper image shows the area around the Sea of Okhotsk as observed by the MODIS sensor onboard NASA's earth observation satellite, Terra. The sea ice distribution can clearly be seen in the image. The sea ice monitoring in the Sea of Okhotsk is quite important from the marine accident prevention point of view. Every winter, the 1st Regional Coast Guard Headquarters sets up the Ice Information Center in Otaru, Hokkaido to collect and disseminate sea ice distribution information in timely manner. Under official request, since February 2003, TRIC has been providing MODIS images of the Sea of Okhotsk to the 1st Regional Coast Guard Headquarters in near real time via the Internet.

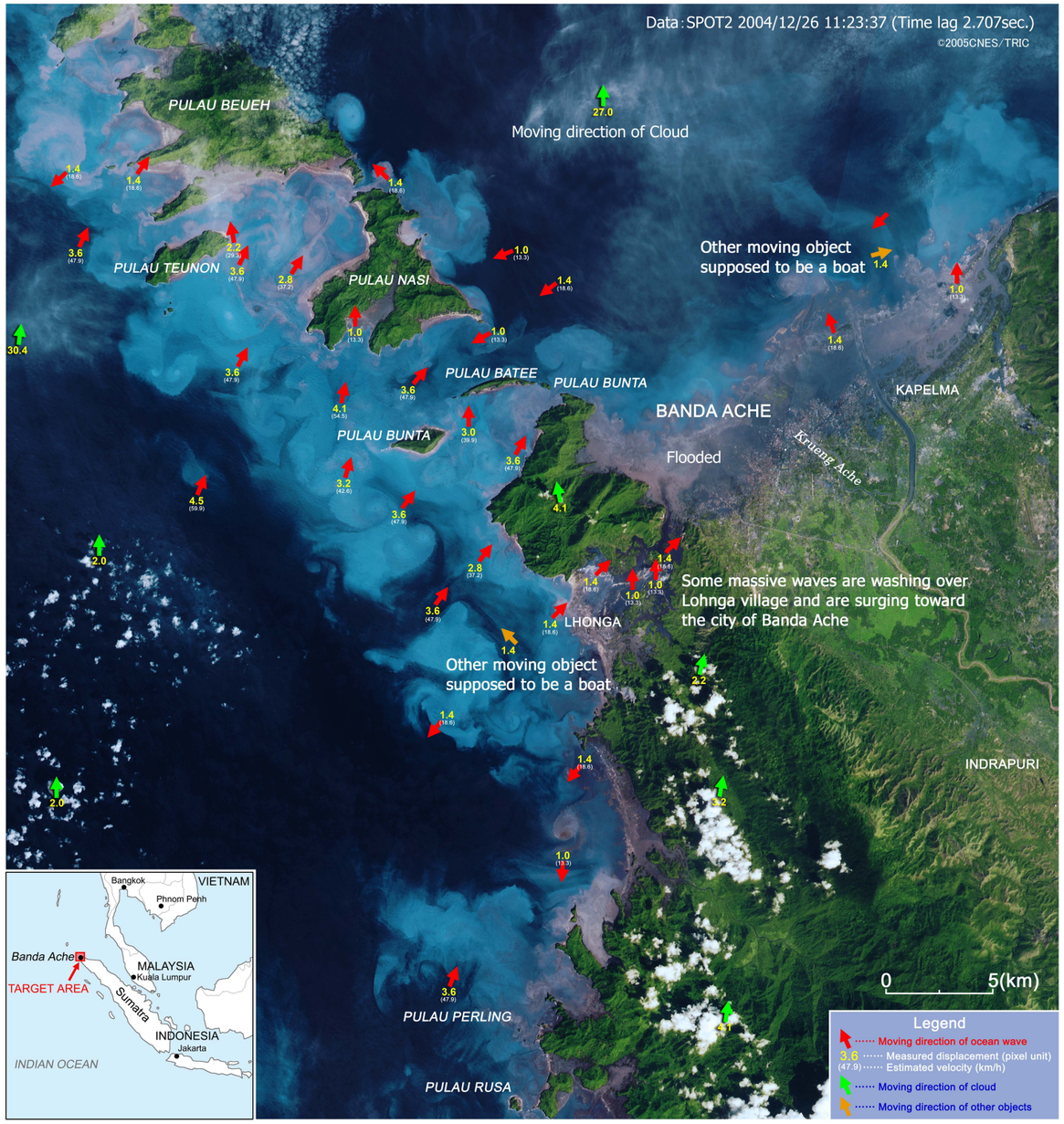
The MODIS data transmitted from the Terra satellite are received at our Space Information Center in Kumamoto Prefecture around 11 am every day. By using our automatic data processing system, the geometrically corrected MODIS images of the Sea of Okhotsk are provided to the Ice Information Center within three hours after data reception. The operators at the Ice Information Center interpret the MODIS images and produce the Sea Ice Condition Chart as shown in the image to the right. The Sea Ice Condition Charts are disseminated to users at 5pm every day via the Ice Information Center's homepage.



WEB site for 1st Regional Coast Guard Headquarters / Ice information Center;
http://www1.kaiho.mlit.go.jp/01kanku/
WEB site for MODIS images around the Sea of Okhotsk;
http://www.tric.u-tokai.ac.jp/rsite/r1/modis/modisokj.html

Data: Receiving Station=TSIC Satellite=Terra Sensor=MODIS Date=2003/03/20 11:42 ©TRIC/TSIC,2006

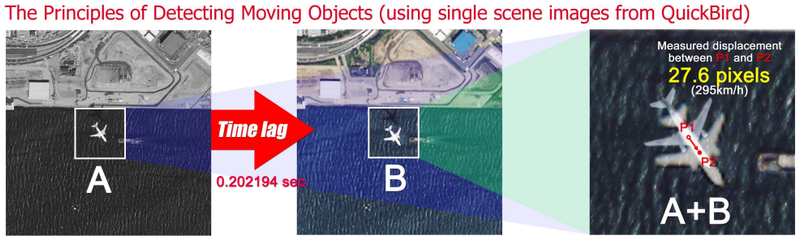
Research on Disaster Mitigation – Satellite Image Analysis of Tsunami Movements



In recent years, interest has grown in the gathering of information for safety in the cases of disasters and conflicts. In order to mitigate disasters, it is important to understand the mechanisms behind the disasters and know in advance what areas may be affected.

At TRIC, we proposed a new method of detecting moving objects using single scene earth observation satellite data. We applied this new method to the analysis of the December 26, 2004 Northern Sumatra earthquake and tsunami. The arrows and numbers on the SPOT image show the estimated propagation and velocity of the tsunami waves. This sort of research development of practical use methods for satellite data is expected to become increasingly important for disaster mitigation.

The Principles of Detecting Moving Objects (using single scene images from QuickBird)



Panchromatic (0.6m/pixel)
2002-05-02T01:27:05.023936Z

Multispectral (resampled in the same size)
2002-05-02T01:27:05.226130Z

The detected moving direction, displacement and velocity

©DigitalGlobe/HitachiSoft

It is possible to detect moving objects, i.e. vehicles, aircrafts, ships, ocean wave movement by overlapping panchromatic and multispectral images of the same acquisition having a certain amount of observation time lag. The velocities of moving objects are roughly obtained by the following formula;

$v(t)=ds/dt$ (where v : velocity, s : object position, t : time)

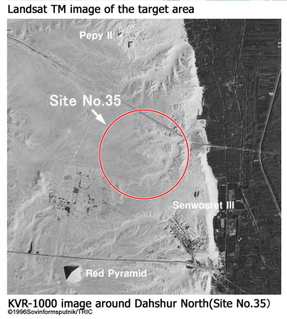
ds is given by the measured displacement between P1 and P2 in pixel unit × ground resolution of the images, and dt is the observation time lag. For example, if the image resolution is 0.6 m and the time lag is 0.202194 seconds, the distance of movement ds would be the displacement between the panchromatic and multispectral images; in other words, the pixel count x0.6m. Thus, the velocity of the aircraft in the image above, which has a displacement of 27.6 pixels, can be estimated at 295 km/h.

Archaeological Site Exploration Using Satellite Data – The Discovery of Ancient Egyptian Remains

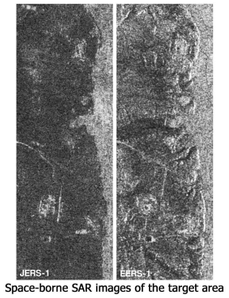
Landsat TM image of the target area

It is thought that there are pyramids and other archaeological monuments yet to be discovered beneath the sands of the desert in the west bank of Egypt's Nile River (called the "pyramid zone"). A joint research team of TRIC and the Waseda University Institute of Egyptology carried out archaeological studies using a wide variety of optical and microwave satellite images. As a result, previously unreported ancient Egyptian remains (Site No.35: Dahshur North) were discovered in the desert area about 25 km south of Cairo.

The most remarkable result of the discovery is a mud-brick structure (the tomb of Ipay) estimated to date back to the New Kingdom, around 3400 years ago. This is the first time in the field of Egyptology that previously unknown remains were detected by satellite data and a successful excavation followed. The excavation of the site is ongoing.



KVR-1000 image around Dahshur North(Site No.35)
©1996Sovinformsputnik/TRIC

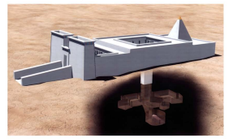


Space-borne SAR images of the target area

Flood simulation of the Nile

Discovery of the tomb of Ipay (foundation of mud brick structure)

Granite Pyramidion



Reconstruction of the tomb of Ipay

Inner anthropoid coffin of Sebek-hat

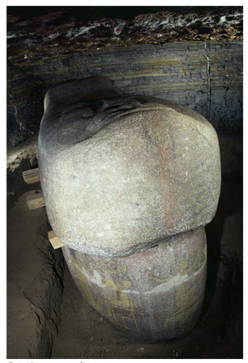
Wooden coffin of Sebek-hat

Coffin of Wiay

Faiance necklace

Relief

Stela



Granite sarcophagus

Tomb of Pashedw

Mummy of Senu with colored mask

Faience ring with the name of Tutankhamun

Faiance ring with the name of Ankhesenamun

Shabti

Colored paimting of Isis

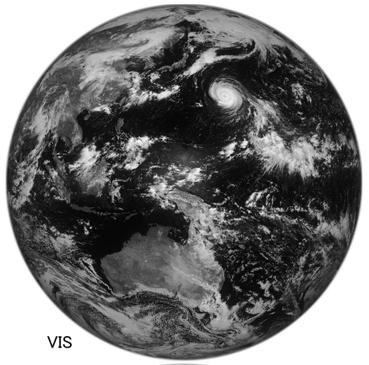
View of the Total Solar Eclipse from MTSAT-1R

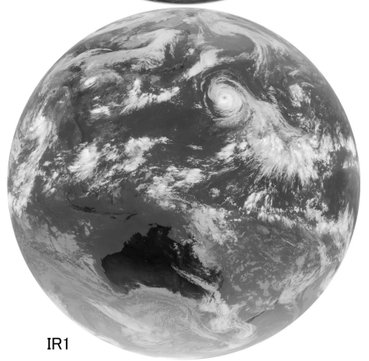
From its stationary orbit at 140 degrees east longitude approximately 35,800 km above the Equator, the MTSAT-1R uses its visible 1ch and infrared 4ch sensors to observe the entire Earth every hour and the northern hemisphere every 30 minutes.

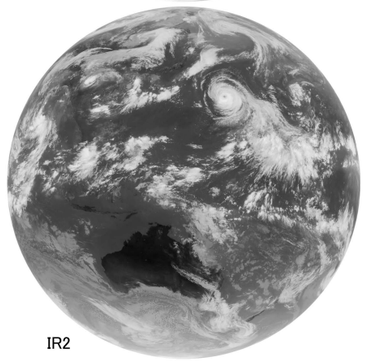
This image is a color composite of the visible (VIS：0.55－0.90μm) channel data of the entire Earth taken by MTSAT-1R and Terra/MODIS images. In this image, you can see the region around Shanghai covered in shadow due to the total solar eclipse.

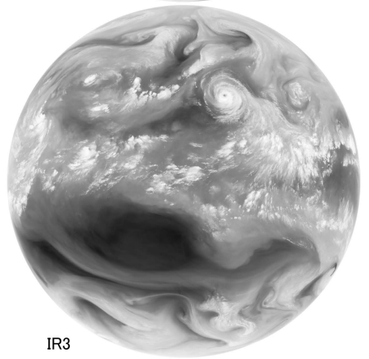
Data: Receiving station=TSIC Satellite=MTSAT-1R Date=2009/07/22 10:36
Image processing： TRIC ©TRIC/TSIC,2009

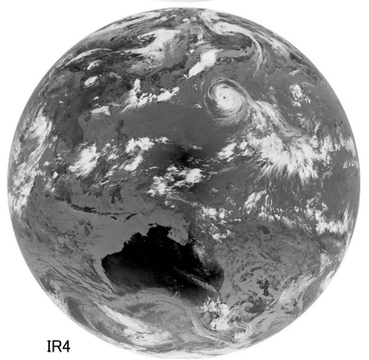
SEOUL
TOKYO
SHANGHAI
Himalaya Range
HANOI
MANILA
JAKARTA


VIS


IR1


IR2


IR3


IR4