کارگاه‌های آموزشی مرکز اطلاعات علمی

آموزش مهارت های کاربردی در تدوین و چاپ مقاله

اصول تنظیم قراردادها

مقاله نویسی علوم انسانی

Science objectives and application of ASTER data

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Abstract
ASTER is one of the five state of the art instrument sensor systems on-board Terra a satellite launched in December 1999. It was built by a consortium of Japanese government, industry, and research groups. ASTER monitors cloud cover, glaciers, land temperature, land use, natural disasters, sea ice, snow cover and vegetation patterns at a spatial resolution of 90 to 15 meters. The multispectral images obtained from this sensor have 14 different colors, which allow scientists to interpret wavelengths that cannot be seen by the human eye, such as near infrared, short wave infrared and thermal infrared.

Keywords: ASTER instrument, Terra satellite.

Introduction

The Ministry of International Trading and Industry (MITI) launched a Japanese Earth Resource Satellite (JERS-1) in 1992, its primary purpose, to investigate Earth resources. JERS-1 users of geology and resource remote sensing have since then requested MITI to develop more advanced sensors than those of JERS-1 in order to obtain more detailed geological data and to understand phenomena such as volcanic activities which would significantly impact the global environment. Responding to their desire MITI developed ASTER. ASTER is the Advanced Spaceborne Thermal Emission and Reflection Radiometer, a multi-spectral sensor onboard one of NASA's Earth Observing System satellites, Terra, which was launched in 1999. ASTER sensors measure reflected and emitted electromagnetic radiation from Earth's surface and atmosphere in 14 channels (or bands). There are three groups of channels: three recording visible and near infrared radiation (VNIR), at a spatial resolution of 15m; six recording portions of shortwave infrared radiation (SWIR) at a spatial resolution of 30m; and five recording thermal infrared radiation (TIR) at a resolution of 90m. The higher spectral resolution of ASTER (compared to Landsat, for example - Fig.1) especially in the shortwave infrared region of the electromagnetic spectrum makes it possible to identify minerals and mineral groups such as clays, carbonates, silica, iron-oxides and other silicates. An additional backward-looking band in the VNIR makes it possible to construct digital elevation models from bands 3 and 3b. ASTER swath width is 60km (each scene is 60 x 60km) which makes it useful for regional mapping. There are a few things to note when using ASTER imagery for regional mineralogical mapping. Firstly, cloud cover, vegetation and atmospheric effects can severely mask or alter surface signals. Secondly, bands and band ratios do not indicate the occurrence of a mineral with absolute certainty or with any idea of quantity, so ground truthing and setting appropriate thresholds is essential. Thirdly, every terrain is different, so ratios which work in some areas for a particular mineral or assemblage may not show the same thing elsewhere. As a result of these factors, it is important not to look at ASTER images in isolation from other data. If possible, datasets such as geology and structural maps, geochemistry, PIMA analyses (ground truthing), radiometrics, and any other available data should be used in conjunction with ASTER for best results.

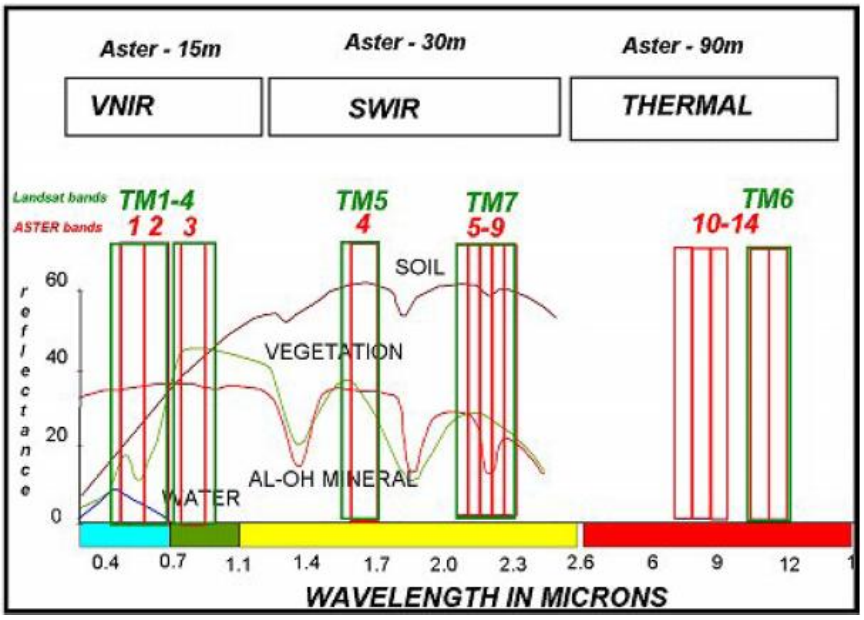

Figure 1. Distribution of ASTER and Landsat channels with respect to the electromagnetic spectrum.

Discussion

ASTER data has the following characteristics.

• High spatial resolution

• Wide spectral range of visible, near IR, short wave IR and thermal IR

• Stereo view in the same orbit Researches taking advantages of these characteristics are planned. Terra also has other sensors namely MODIS, MISR, CERES, and MOPITT which have different features from ASTER (Fig.2). Combination of ASTER data and data from other sensors can provide better atmospheric correction and vicarious calibration. The multiple payloads on Terra also enable observations that were not possible with only one sensor.

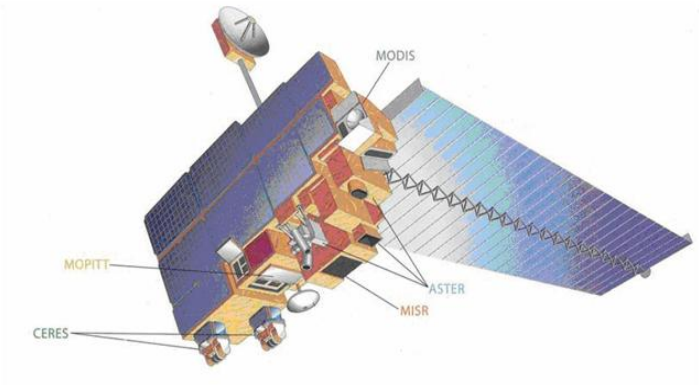

Figure 2. Terra and its five climate-monitoring sensors.

Spectral separation capability is one of the most important features of ASTER instrument. The central wavelength and width of each band was carefully selected to meet the scientific requirements, especially for SWIR and TIR bands. Figure 3 shows the measured values of the

central wavelength, the momentum center and the band width together with the specification. It should be noted that the difference between the central wavelength and the momentum centers is very small.

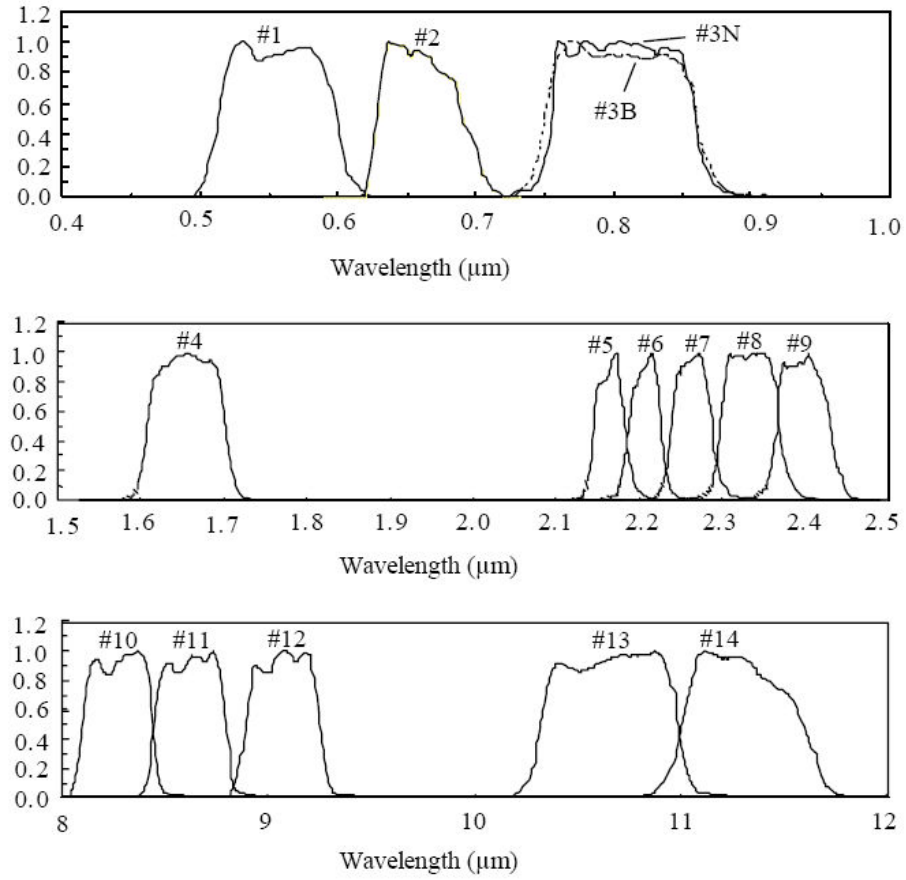

Figure 3. spectral response profiles.

The purpose of the ASTER Project is to make contributions to extend the understanding of local and regional phenomena on the Earth surface and its atmosphere. The goals are as follows.

1. To promote research of geological phenomena of tectonic surfaces and geological history through detailed mapping of the Earth topography and geological formation. (This goal includes contributions to applied researches of remote sensing.)
2. To understand distribution and changes of vegetation.
3. To further understand interactions between the Earth surface and atmosphere by surface temperature mapping.
4. To evaluate impact of volcanic gas emission to the atmosphere through monitoring of volcanic activities.
5. To contribute understanding of aerosol characteristics in the atmosphere and of cloud classification.
6. To contribute understanding of roles the coral reefs play in the carbon cycle through coral classification and global distribution mapping of corals.

Sample proposed researches applying ASTER data are as follows.

1) Land area

• Monitoring of active volcanoes and observation of eruptions
• Monitoring of coastal erosion and sedimentation of the U. S. Atlantic and the Gulf coasts
Geological study of African Graben, Southern Mexico, and the Andes
• Monitoring of vegetation in tropical rain forests
• Monitoring of swamps
• Estimation of energy flux on land surface
• Generation of digital elevation model (DEM) for topography of the South Eastern Asia
2) Sea and limnetic areas
• Mapping and establishing coral reef database of Western Pacific
• Monitoring of turbidity and aquatic vegetation
• Sea surface temperature analysis of coastal areas
3) Snow and ice
• Monitoring of glacier movement in Antarctic coast
• Analysis of paleoclimate by glacier observation in the Central Asia
• Analysis of sea ice distribution, albedo and temperature of iceberg
4) Atmosphere
• Cloud classification
• Monitoring of cloud and ice in polar regions

Summary
The ASTER instrument, provided by Japan's Ministry of International Trade and Industry and built by NEC, Mitsubishi Electronics Company and Fujitsu, Ltd., will measure cloud properties, vegetation index, surface mineralogy, soil properties, surface temperature, and surface topography for selected regions of the Earth. Hundreds of scientists from the U.S. and abroad are prepared to take full advantage of Terra observations to address key scientific issues and their environmental policy impacts.

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