ASTER THERMAL TEMPERATURE AND EMISSIVITY VALIDATION ON VOLCANO TEIDE

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Introduction

The Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) has operated since 19 December 1999 from NASA's Terra Earth-orbiting, sun synchronous satellite. Emissivity and temperature standard products are based on the TES algorithms and required periodical validation campaign. In the frame of the EC project PREVIEW (http://www.preview-risk.com/) a field campaign on Volcano Teide was carried on, from the 16th to 24th of September 2007, to validate and to integrate the satellite derived products services. Mt. Teide volcano (Pico del Teide) is a large stratovolcano located on Tenerife island which is the largest of the Canaries (28.27 N, 16.6 W). The volcano has an altitude of 3717 m above sea level and approximately 7500 m above the floor of the Atlantic Ocean, it is the third largest volcano on Earth. Mt. Teide is an active though dormant, which last erupted in 1909. The United Nations Committee for Disaster Mitigation have designated Teide as one of 16 volcanoes as being worthy of particular study in light of their history of large, destructive eruptions and proximity to populated areas. In-situ ground-based spectroscopic measurements were realized on a series of target sites, representative of both recently and oldest volcanic surfaces. Measurement were made using a microFTIR (by Design and Prototipe) [6] was used for emissivity measurements in the mid-infrared (8-14micron) while an ASD FieldSpec Pro portable spectrometer operating in the 300-2500nm wavelength range for reflectance. Temperature measurement contemporaneous to ASTER night passage were acquired by EVEREST. Here we present the results of the comparison among emissivity measurements and AST08 products [2] and the validation of the temperature .

Method description

ASTER's thermal spectral radiance images contain information about surface composition, especially silicate mineralogy and surface temperature [7]. ASTER standard products (AST05 and AST08 emissivity and temperature respectively are retrieved by Temperature/Emissivity Separation (TES) algorithm, wich uses a quasi-empirical relationship between spectral contrast and minimum emissivity, to scale the estimated emissivities. [5] [8]. The ASTER night data acquired on demand on 17 September 2007 is used.

Validation site

The campaign of measurements war carried on Volcan Teide part of the Canary Islands archipelago. (Lat 28° 16' 30" Lon 16°38' 42") from the 16th and 24th of September 2007 as part of EC project PREVIEW FP6 activities((http://preview-risk.web.cern.ch/preview-risk/preview.aspx).

Volcan Teide on Tenerife Island, Teide has been chosen for several different reasons: its current activity is related to persistent fumarolic activity at the summit crater and, though active, does not change much with time, a key point in the choice of a calibration test site. For the validation phase, in situ measurements are thus very important because they represent the "in situ truth" (end-members) [3].

The field site was selected based on the following criteria:

a) It has to be spatially large enough to contain a minimum of nine 90m ASTER pixels;

b) The site has to be compositionally homogeneous as possible in order to minimize spectral heterogeneity;

c) It has to be flat and easy to access.

The Lano the Ucanca (N 28° 12' 46.9'' E 16° 38' 10.0'') is a flat area located in the southeast part of the Las Canadas Caldera (LCC) of 1.8 km length and 0.75 km width. Llano de Ucanca is constituted by colluvium deposit recent in age [1] [4]. The site contain smooth, flat and spectrally homogenous with little to no vegetation.

In field measurements and temperature validation

The in field emissivity measurements have been realized by FTIR, Model 102F . It is a portable Fourier Transform InfraRed. It has two liquid nitrogen cooled detectors, HgCdTe (or MCT) and InSb, for measurements collection in the 8-14 μm and 3-5 μm atmospheric windows respectively .

A protocol for the FTIR measurement has been implemented in order to assure repeatability and good accuracy of measurements. Ten sites, characterized by different volcanic rocks surfaces has been measured.

In situ temperature measurement has been realised during the ASTER night passage on September 17th 2007. The instrument used is the EVEREST 130,2L; it is an infrared thermometer in the (8 -14)μm spectral range configured like a gun. An operator points the instrument at the target where he wishes to make a temperature reading. Instantly he can read that temperature measurement on the liquid crystal display, which gives a readout of the temperature. The measurements were taken normally to the surface and at a distance of about one meter or less than one meter; this means a spot on the surface of less than 7 cm of diameter. The temperature acquisitions were made of a grid within the validation site [9].

Results and discussion

Comparison of in situ emissivity measurements with ASTER05 product has been realized. The comparison has showed a good agreement for bands between 10-micron14micron, about 0.2-0.8%. As regards spectral bands between 8-9 micron the comparison has point out some differences in spectral shape and higher difference percentage errors (a maximum of about 6%) probably to atmospheric correction. This suggest to use local profile to improve the correction. The temperature validation shows a quite good agreement with measured data.

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