EUROSDR ICC BANYOLES 2008 CAMPAIGN DATASET AND RESULTS

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1. INTRODUCTION

In 2008 the European Spatial Data Research (EuroSDR) organisation undertook a collaborative applied research project focused on Radiometric Performance of Digital Cameras. The project has these main objectives:

a) Improve knowledge on radiometric aspects of digital photogrammetric cameras.

b) Review existing methods and procedures for radiometric image improvements.

c) Compare and share operative solutions through a comparison of these techniques on a same test data set.

d) Analyse the befit of radiometric calibration in order to open new applications (classification).

The EuroSDR radiometry project has two main stages: Review and Empirical study. As a EuroSDR activity the Institut Cartogràfic de Catalunya led Banyoles 2008 campaign as a part of the empirical study, in collaboration with other cartographic institutions (Finnish Geodetic Institute, FGI), universities and research centres (Centre de Recerca Ecològica i Aplicacions Forestals, CREAF; Instituto de Desarrollo Regional, IDR-UCLM; Universitat Politècnica de Catalunya, UPC; Universitat de Barcelona, UB and Servei Meteorològic de Catalunya, SMC).

EuroSDR Banyoles 2008 goals are:

i) Radiometric calibration of a Z/I Digital Mapping Camera (DMC) by the radiance and the reflectance methods. Validation with radiometric targets. Radiance method will be performed with the simultaneous acquisition of a Compact Airborne Spectrographic Imager (CASI).

ii) Spectral characterization of a Compact Airborne Spectrographic Imager (CASI) regarding bandwidth and smiling effect. Comparison with on laboratory results.
iii) Atmospheric correction of CASI imagery with aerosol distribution and load, and water vapour derivation by an inversion method. Validation with radiometric targets and atmospheric measurements.
iv) Atmospheric correction of DMC images by using CASI derived atmosphere parameters. Validation with radiometric targets.
v) Colorimetric calibration of DMC sensor towards CIE standard colour space. Validation with radiometric targets.
vi) Resolution studies by means of Siemens star and edge targets. Study of the relationship between atmosphere state and resolution. Comparison with computer radiative transfer simulations.
vii) Application of DMC radiance and reflectance images to remote sensing studies such us land use and classification, change detection, water quality, forest and vegetation analysis, etc.

The campaign was held on July 15th 2008 in Banyoles (Spain) area. A CASI, a DMC and an Incident Light System (ILS) take data from a plane over ICC test field. On the test field several radiometric and resolution targets were deployed for the acquisition. Besides, the imaged area contains several natural and man-made covers. These areas are suitable to be used as reference radiometric targets.

Simultaneously an exhaustive field campaign was undertaken by CREAF and IDR-UCLM to obtain reflectance measurements on the test field and the rest of the area, including still water from a lake. Atmospheric ancillary data was obtained from the test field by means of an atmospheric Lidar operated by UPC, a sun photometer measurements performed by UB. In addition, meteorological data and information was provided by SMC.

This paper is an overview of the available data from the campaign, and of the expected results obtained by the collaborators and other research institutions that applied for the dataset.

2. DATASET DESCRIPTION

Airborne data was acquired from flight lines computed to minimize the bidirectional reflectance effect. CASI sensor acquired hyperspectral data from three altitudes (DMC acquired multispectral data from an additional altitude) with multiple overlapping flight lines from each altitude. GSD for CASI ranged from 1.5 to 6 m. GSD for DMC pan data ranged from 10 to 40 cm and multispectral data ranged from 0.4 to 1.6m. ILS data for each flight line was collected and calibrated to a single irradiance value for each CASI acquisition of CASI. As it takes a short time, this approximation is accurate and noiseless.

The UCLM and CREAF groups performed radiance and reflectance measurements with GER VIS-NIR and an Unispec UNI003 by Ppsystems VIS/NIR field radiometers along the acquisition data day (15th July). The total measuring time was reduced to fife hours around the flight-time (from 9.00 AM to 14.00 PM). Thus, the in situ spectra measurement and the airborne image capture took almost concurrently. In order to improve our effectiveness when measuring the fully field campaign was previously designed. The target sites consisted of invariant surfaces, i.e. no changing characteristics of the surface for the acquisition time. Besides, five colour canvas (man-made covers) provided by ICC (red, blue, green, black and white) were measured in concurrence of both groups. The selected invariant surfaces were: bare soil and man-made covers, vegetable cover: green fields, static water (Banyoles lagoon), cereal stubble, fine gravel bed and asphalt.

The UB CIMEL sun photometer CE318 is composed of an optical head, an electronic box and a robot for sun tracking. It measures sun and sky radiance to derive total column water vapour, ozone and aerosols properties using a combination of spectral filters and azimuth/zenith viewing controlled by a microprocessor. The sun photometer of the University of Barcelona has 8 spectral filters: 340, 380, 440, 675, 870, 936 and 1020 nm. 2. Field measurements recorded were two series of data corresponding to the first hour of the campaign. Each data set contains the optical mass, the aerosol optical depth for each wavelength and the Angstrom parameters (alpha and beta). The aerosol optical depth show low values indicating very low turbidity during the campaign. On the other hand, the aerosol size was small as the Angstrom exponent indicates. The atmospheric conditions and the in-situ observations made during the campaign suggest that the measurements would remain constant throughout that morning.

The UPC lidar was transported in a van and operated in a zenith-looking configuration (see fig. 2) and set to simultaneously measure the 1064-nm and the 532-nm elastic backscattered radiation. An APD-based photoreceiver was used for the 1064-nm return and a PMT for the 532-nm return. A 150-minute continuous measurement with a temporal resolution of 1 minute was launched at 7:57 UTC (9:57 local official time) on 15 July 2009. The plane overpasses took place in this 150-minutes time interval. A second 30-minute measurement was done starting at 10:37 UTC (12:37 local official time). Lidar inversion with data acquired at 7:57 UTC yield that lidar ratio values at 532 and 1064 nm are 57 sr and 30 sr, respectively. The resulting lidar AOT is 0.082 and 0.027. All the rest of the profiles were inverted with those values of lidar ratio. The inversion results show a temporal evolution of the boundary layer that raised with time and a second layer on top of the boundary layer appears after 8:27 UTC. In all profiles aerosols are observed up to 3 km. After 8:57 UTC a very shallow aerosol layer was also observed around 4.5 km on some of the profiles.

The SMC provided weather forecast and some ancillary meteorological data from Banyoles automatic weather station data. As a real radiosounding was not available for the area, a MM5 metrological model vertical profile estimated at 12:00 UTC of the acquisition day (June 15th 2008) was provided.

3. EXPECTED RESULTS

EuroSDR Banyoles 2008 goals are now been developed by ICC, UCLM and CREAF. Besides some other research institutions applied for the dataset. They are collaborating to succeed with the objectives of the Banyoles 2008 experiment. It is expected that during the first half of 2010 all the goals of the experiment will be accomplish. This communication will be an overview of the general results on radiometric and colorimetric calibration, atmospheric correction and resolution measurements made with the airborne data.

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