BASIC REMOTE SENSING TRAINING OF NON-GRADUATE IMAGERY USERS "AN EXPERIENCE FROM UNITED ARAB EMIRATES, AIR FORCE GROUND STATION"

Ghassan A. Abdelhamid

Training Advisor, UAE Air Force & Air Defense, P.O. Box 55260, Abu Dhabi, UAE - falcongs@emirates.net.ae

Commission PS , WG VI/1-3

KEYWORDS: Remote Sensing, geology, mathematics, education, interpretation, processing

ABSTRACT:

Success in imagery understanding and interpretation is greatly dependant on our knowledge of the earth surface geography and geomorphology as well as all kinds of man-made features and activities, which has changed the nature either positively or negatively in considerable areas on Earth. It is quite important to know about the components of the earth surface and physico-chemical factors, which has controlled the development of the surface and configurations of image elements including soil/rocks, vegetation and urban activity. To achieve a reasonable understanding of an image or map, one should start with knowing or revising relevant scientific phenomena's of chemistry, physics, geology/ geomorphology / geography, basic mathematics and statistics, maps and how to use computers. This introduction to basic scientific concepts will be followed by an introduction to map reading & projections, remote sensing, image processing, principles of imagery interpretation and an overview of imagery applications with emphasis on the specific field of application of each user.
Practically oriented education of imagery users is very essential for better utilization of images and enable profitable investments in remote sensing technology applications.

1. INTRODUCTION

1.1. Motivation and aim

From the fact that I am working as a remote sensing, image processing & interpretation and maps training advisor in the United Arab Emirates (UAE), Universal Ground Station (UGS), for the past five years, and because the majority of the technical employees are undergraduates; with high school or diploma certification, it was necessary to implement a practical & reasonable basic training program. This program is designed only for new employees or imagery users without any relevant background on remote sensing & maps. The aim is mainly to enhance the understanding of scientific phenomena's related to remote sensing and maps with emphasis on practical issues to help building a reasonable imagination and understanding capability on how various ideas and concepts are interrelated and integrated, to end up with a person who can correctly read a map and interpret an image.
One encouraging and success factor is that the training cell of the UGS is equipped with latest workstations, image processing & GIS software products, data projection facility and availability of different kinds of images parallel with qualified trainers. This trial program intended to simply address the subject first to imagery users who cares about visual interpretation of hardcopy prints or just investigating images on computer monitors, and secondly to those aiming to work as professional image analysts and image-map production specialists. The availability of images and software products in the UGS enabled us to correctly address the subject through image illustrations.

1.2. UGS overview

UAE was among the first countries to utilize high-resolution images from all available commercial sources, including IKONOS, SPOT, Quick Bird, Spin 2 as well as aerial photographs collected by reconnaissance aircrafts and unmanned aerial vehicles, for UAE territories and the surrounding countries.
In 1999 H. H. Sheikh Mohammad Bin Zayed Al Nahyan, Chief of Staff of UAE Armed Forces, patronage the establishment of a national ground receiving station, and the UGS was operational in late 2000, with help of Space Imaging, the owner of IKONOS imaging satellite, a worldwide leading company in high resolution satellite imaging business. Currently the UGS directly receive imagery data from three satellite groups; IKONOS, IRS and KOMPSAT.

During 1999 and up to October 2000, a total of 20 officers and soldiers were trained by Space Imaging in USA, ITC in Netherlands and in the Space Reconnaissance in Abu Dhabi, on basics of remote sensing image processing, map reading and image map production. Later on, trainees in small patches got specific training on the application products required for running a specific operational cell in the UGS; Satellite Tasking & Controller, IRS Satellite data processing, Radio Frequency Terminal operations, Requirement Manager, Image Analysis & Production and Data Base Management.
In year 2001 few experts from Space Imaging came over to UGS for on the job training and some employees were sent abroad for specific training at operational level to keep them up to date with latest system upgrades. In 2002 the UGS was fully operated by nationals with only limited support by Space Imaging help-disk and trainers who look after the basic training and solving some system related problems.

2. METHODOLOGY & REQUIREMENTS

The training process in general consists of four principal elements; trainees, trainers, materials& procedures and training requirements. In addition, there will be an objective to achieve a certain level of command in the real life operational level. The trainee's education level, experience and language are the

UGS Training Cell Facilities

-Three fully equipped rooms; workstations, computer projection, soft-board, video display, network

- Two permanent image processing & GIS trainers

- COTS SW products

Figure 1. UGS training cell facility

basic factors that determine the level and kind of training material and way of addressing the subject. In our case study; in the UAE UGS, we are dealing mainly with high school to diploma education levels, with low to medium command on English. It is quite important to have, wherever available, Arabic or local language speaking trainers to make it easy for trainers to follow-up and understand things simply and gradually. From the fact that the majority of our scientific resources & references are in English, trainees should have a reasonable command on English before proceeding to professional training.

Employments in a fully operational satellite receiving station will range from computer specialists, who look after software & hardware problems, to communication & electronic engineers who can understand and operate radio frequency terminals and GIS, remote sensing and mapping specialists who can operate satellite data receiving, processing and analysis as well as production of various kinds of imagery and image map products.

Since we are mainly interested in the basic training, which is aimed to enable the new employees build-up a reasonable level of knowledge and understanding basic concepts related to maps, images and their interpretation, a program was customized to suite such a requirement, taking into account the scientific and language levels of the trainees.
This basic training program is executed over a period of two months with six hours daily lectures &/or practical. The UGS has a library with 100's of reference books, magazines and journals both in English & Arabic, which assess the training process and enhances knowledge of UGS staff.

3. STAGES OF THE BASIC TRAINING PROGRAM

3.1 Logical order

Because most of the trainees are beginners to the remote sensing, image processing and maps, and even those who know some parts have been out of touch for along time, I tried to follow a simple & logical order in addressing the subjects (figure 1).

3.2 Interviews and evaluation exam

First an interview is made with each trainee separately to know his general background & experience and his English language capability.
The interview will be usually followed by a written evaluation exam, that involves topics such as guessing measurements and dimensions of known objects, general information on remote sensing & maps and simple translation of few sentences.

3.3 Program structure

An overview on the program structure, its objectives and importance of their future role in the society as specialists in space reconnaissance and importance of imagery in both military and civilian aspects of life.

3.4 Overview on science branches and measures

From the fact that remote sensing, image processing and maps are interrelated with many scientific branches, the program involves logical understanding of basic relevant concepts in geography, geology, chemistry, physics, mathematics, engineering and computers.
In his Arabic book on remote sensing, Abdelhadi stressed on the diversity of subjects that are interrelated with remote sensing because it is a multidisciplinary field (Abdelhadi, 2000).

3.5 Earth surface constituents & terrain categories

It is important for trainees to know the general geography, geology and geomorphology of the earth and how the surface has evolved to the current shape. Here, there is a need to emphasize on the terrain categories, which are actually the natural constituents and man made features, these will consequently be the image elements that are collected from various platforms, and later on need to be interpreted.

To correctly address this subject it is better to start gradually building an imagination ability and understanding of the composition of big and small things around us, starting from the fact that our globe is part of the Solar System, which is in turn part of the Milky Way Galaxy; a very tiny portion of the extremely huge Universe.
Since the earth surface is the ultimate target of our imaging instruments, it is very important to understand its evolution, composition, dynamics & morphology.

3.6 Introduction to maps and map projections

Review and discussions the globe shape, distribution of continents and oceans, Longitude/Latitude subdivisions, time zones, drawing map of the world, map of the region, map of the country, types of maps, scale, reading of topographic maps at different scales; map elements, distances, orientation of features, areas & coordinates of polygons.

3.7 Introduction to computers

For those without computer knowledge, a few days course on how to use the computer will be enough to enable them utilize and understand the basic tools and functions required later for viewing, processing & interpretation of images as well as writing relevant reports.

3.8 Translations and abbreviations

In addition to the few available Arabic references, I made translation for the commonly used terms in remote sensing parallel with a comprehensive English and Arabic summary on remote sensing, image processing and interpretation. A list of commonly used abbreviations (NIMA website) in maps and images was compiled.

3.9 Introduction to remote sensing, image processing & interpretation

Include physical principles of remote sensing; EMS regions and interactions, image acquisition, digital image structure, resolution vs. scale, image histogram, image corrections and enhancement, image filtering, classification and annotation.
The resolution vs. scale is an important issue (Belcon & others, 1997) in both interpretation and map production.

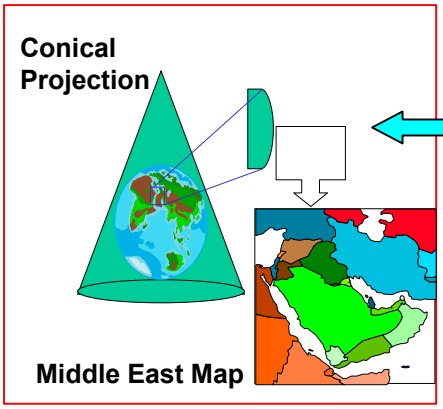
This is supported by practical exercises on image processing, interpretation and image map production using various kinds of images available at UGS archives; IKONOS, IRS & KOMPSAT and images from external sources.

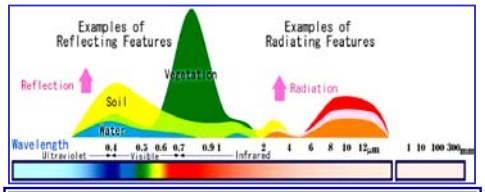
1. Overview of scientific background

Understanding the Earth surface constituents and evolution, review of measures, dimensions, scales with review of Space and Solar System

2. Introduction to maps & Projections

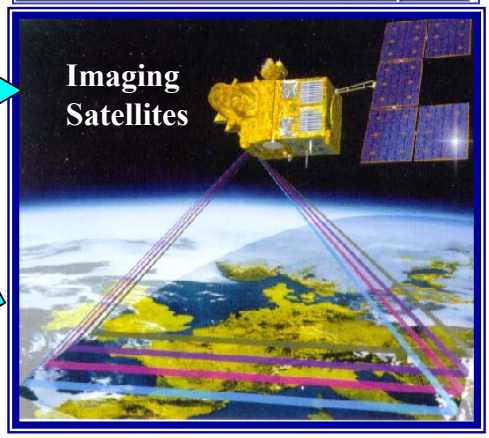
To know how to read maps and understand the basic concepts of scale and map projections, with emphasis on practical exercises





3. Remote Sensing & Image Processing

To understand physical principles of remote sensing, acquisition of images, image resolution, correction, enhancement and interpretation methods



4. Image Map Production

Designing & annotating image maps, estimation of map scales from various image types and printing & exporting images

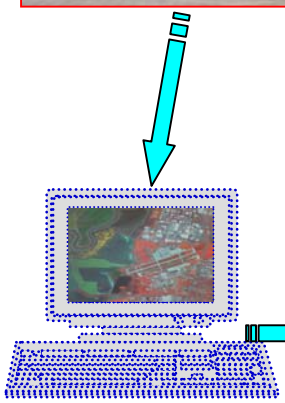


Figure 2. Main stages and workflow of a basic training program designed for non-graduate imagery users

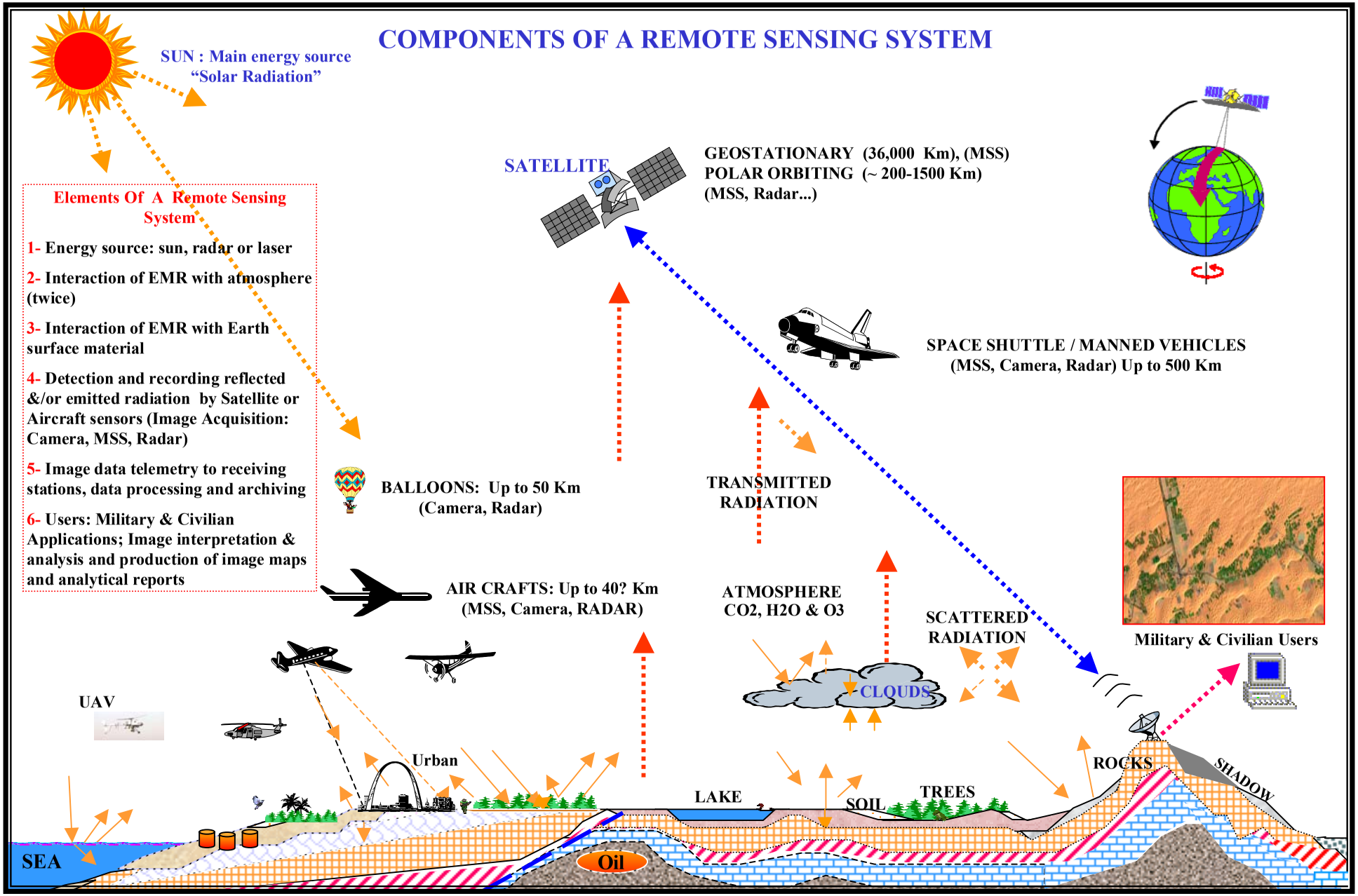


Figure 3. Components of a remote sensing system.

It is quite important to enhance 3-d imagination and feeling parallel with logical estimation of objects dimensions as well as types of features that can be determined from a particular image.

3.10 Introduction to geographic information systems (GIS) and global positioning systems (GPS)

To familiarize the trainees on the basic concepts of GIS including its importance and data inputs parallel with an overview on GPS components.

3.11 Applications of remotely sensed images

Although we are more interested in military applications, It is important to give an overview on remote sensing applications in monitoring and protecting the environment, urban planning, monitoring of agriculture activity, mapping & exploration of natural resources and meteorology.

3.12 Practical exercises and tests

A large number of practical exercises, quizzes and exams are scheduled, with some sort of repetition in subjects like measurements, scale and maps. This is quite necessary to strengthen the ability of map & image interpretation and 2d vs. 3d geospatial thinking and imagination.

4. COMPILATION OF TRAINING MATERIAL

A training manual has just been compiled as a draft, involving the majority of above topics and ideas in the same logical order as stated above. This manual (Abdelhamid, 2004), involves five main topics as follows: getting started (science branches and earth evolution and composition), introduction to maps & map projections, introduction to remote sensing, image processing & interpretation, introduction to GIS & GPS and a chapter on miscellaneous topics including UGS overview, scientific methods, translation and abbreviations of terms & measures. A large number of figures and images are attached, especially to enhance image interpretation capabilities. Some figures involve parts chopped from the associate cartographer training held at Inha University in Soul – Korea (Associate cartographer training, 2001) and some others modified from illustrations given on the website of Canada Center for Remote Sensing.

5. ADDITIONAL SPECIALIZED TRAINING

After the basic training stage, the trainees should have built a good background in remote sensing and imagery capabilities, a step that enables them to be enrolled in advanced training courses, necessary to qualify them to work in the operational cells at the UGS, or any other equivalent applications elsewhere. In our case study, the UGS, trainees are usually enrolled in one or more of the following courses: IKONOS Satellite tasking and controller, requirement manager, radio frequency terminal unit operation, IRS & KOMPSAT imagery archive and processing, image analysis and database management and advanced image production including both image processing, photogrammetry and GIS products. In UGS, we have sent training batches for long periods of specific training in ITC of Netherlands (Remote sensing, image processing & GIS), Inha University, Soul, Korea on a customized training specified by us for associate cartographer training and to Space Imaging Primary Operations Center (Image interpretation & analysis, Satellite Tasking & Controller and Requirement Manager). The venders of operational products usually come over and provide in-house training, using UGS facility.

6. CONCLUSIONS

6.1 In the basic training of non-graduates, it is necessary to enhance the background of trainees through revision of basic relevant scientific concepts and theories; particularly geography, geology and geomorphology to understand earth surface components and consequently image elements.

6.2 Among the success factors in the training process we mention, availability of local language trainers, equipment & software and images from different sources.

6.3 It is quite important to concentrate on intensive practical exercises parallel with tests, particularly for maps and image understanding.

7. REFERENCES

Abdelhadi, B., 2000. Reference on remote sensing: science and applications. Technical Supplies Inc. Cairo Egypt.

Abdelhamid, G., 2004. Introduction to remote sensing, image processing & maps. Space Reconnaissance, Abu Dhabi, UAE.

Belokon. F and others (Spectral Imagery Training Center). 1997. Multispectral Imagery Reference Guide, Logicon Geodynamics Inc. Fairfax, VA, USA.

Associate Cartographer Training Manual, 2001. Intelligent GIS Research Center, Inha University, Seoul, South Korea.

8. ACKNOWLEDGEMENTS

Great appreciation to H.H. Sheikh Mohammed Bin Zayed Al Nahyan, Deputy Crown Prince of Abu Dhabi & Chief of Staff of UAE Armed Forces, for patronage of establishment of the UGS, with the latest possible technologies, and to Brigadier General Khalid Abu Alainain, Commander of UAE Air Force & Air Defense for supporting the UGS requirements. Thanks go to Colonel Mahash Alhameli, Director of Space Reconnaissance, UAE Air Force & Air Defense and Major Ali Alshehhi, Manger of UGS for supporting the training cell of UAE, UGS and for continuously keeping the UGS staff up to date with technology developments and system upgrades.