



## **VEGETATION MONITORING AND CHANGE DETECTION USING M2C TECHNOLOGY AND VisCMSE SOFTWARE**

### **GENERAL PRINCIPLES**

The ability of the AZ GLOBAL propriatory VisCMSE (Visual Control, Monitoring and Simulation Environment) software to combine monitoring, image processing and modeling within the same application may be effectively used for classification of the soil conditions and for issuance the recommendations for planning of the agricultural activities. The proposed approach is based on already existing software, which supports identification of the similar ground surface cover areas using their spectral “signature”, derived from the multispectral satellite image, and on standard set of the M2C capabilities, as described in the “M2C MODELLING, MONITORING AND CONTROL TECHNOLOGY” brochure. Within this methodology and considering the fact that M2C applications are designed to monitor and trend large numbers of parameters that are related to large number of objects the following approach was be taken:

- (1) The monitored area is be separated into a set of objects (actually, separate fields) following existing Land Cadastral boundaries.
- (2) Within each object the area, which is free from the boundary effects is defined, and monitoring application which includes all the mentioned objects, weather data, fertilizer data, and vegetation type data will be created.
- (3) The optimal satellite / image provider shall be selected based on the following criteria:
  - Maximum number of separate bands
  - High enough resolution to receive reliable reflection data without boundary interference
  - Low enough resolution to keep the cost under control
  - Long enough remaining period of operation to maintain data continuity (5 years at least)

The likely candidate is USA Landsat-7, but the issue has to be re-visited to be more certain.

- (4) After the provider is selected, the image of the same area using the same instruments has to be taken each (preferably), or every second re-visit (every 24-36 Or 48-72 days).

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8630M GUILFORD ROAD, UNIT 123, COLUMBIA, MD, 21046 USA  
Tel.(410)300-6590; Fax: (403)451-1426

522-310 MONTREAL ROAD, OTTAWA, ON, K1K 4T0 CANADA  
Tel.+(301)606-6850; Fax.+(403)451-1426  
<http://www.azgre.com>



- (5) The application will standby and collect weather data (from NOAA GMES or Meteosat satellites), constantly updating the history files for weather, etc., during the time period between images are taken.
- (6) After next image is accrued, it has to be georeferenced and automatically processed during the nearest monitoring update of the M2C application. The spectral data (averaged over the sampling area) are added to the history file for every object.
- (7) After data added to the history file they are automatically analyzed using built-in analysis model, and report with recommendations is issued and automatically distributed using M2C notification features.

## SYSTEM OPERATION

### **New image processing**

The system operates in semi-automated regime and has to be deployed as a separate application (possibly within the same master VisCMSE application) for every monitored area. VisCMSE is deployed on the server computer that has to be accessible (over LAN or WAN) for the satellite ground station for downloading newly received images. As soon as new image arrives VisCMSE informs the operator that new image is available (Fig.1, orange tab; audio notification is optional).

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The operator has to decide on whether the particular image shall be used by the given application. The options are:

- to move the image to the archive without integration in the particular application,
- to integrate image into application as image for particular object,
- to integrate image into application as a map for particular object,
- to integrate image into application as external resource for particular object without changing the map and the image of the object.

In any case the image itself remains archived, and only network address is passed to the application for retrieving the copy of the image from the ground station's archive.

If either use option (except for archiving) is selected, the application brings up the georeferencing workplace where newly arrived image is pre-positioned according to the coordinates that are supplied by the image processing unit of the ground station. The operator may either leave it as it is, or refine the positioning of the image manually. After

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operator is satisfied with image positioning, image is integrated into the system by single button click. The entire process of integration of the image into system takes less than 10 minutes.

## Ground surface conditions and change detection

If image is integrated as external resource, it becomes immediately accessible for ground cover monitoring applications and for change detection applications which may be integrated into individual nodes of the system. The analysis is performed via comparing the new and the previous messages by band pixel-by-pixel (with proper calibration) for change detection, and via deriving average by-band over the object's footprint area for ground cover / vegetation monitoring.

In the case of ground cover analysis new data are added to the data log for particular object. These logs are the used to generate 3D (Intensity of reflection vs. time and bandwidth) chart of the spectrum and of the spectrum change for each monitored object. The absolute (calibrated by the 1-st band) values of the spectral intensity are also available. Correspondent plug-in is activated by pressing the “resource selector” button (large button at the top of the state analysis panel).



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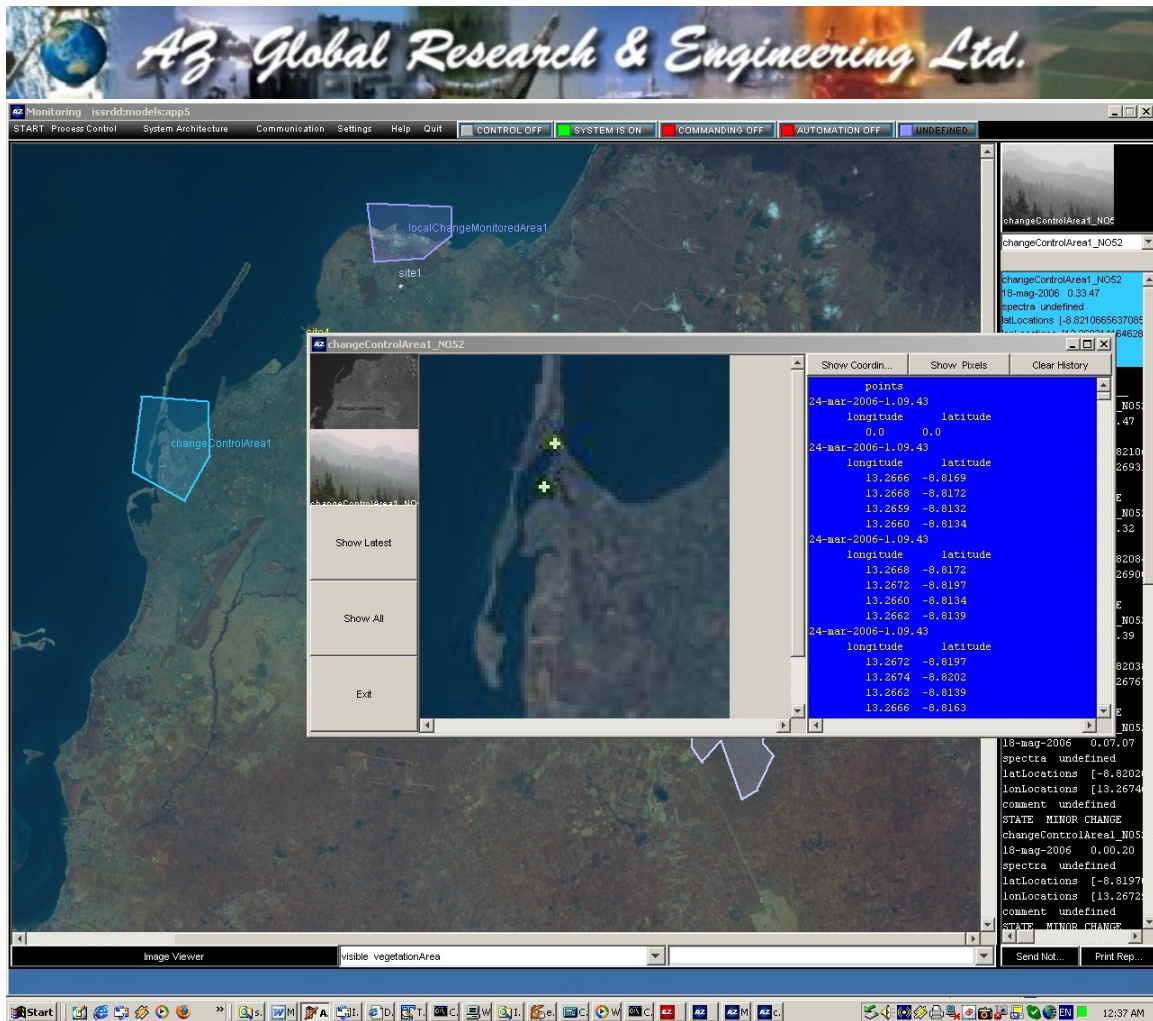
522-310 MONTREAL ROAD, OTTAWA, ON, K1K 4T0 CANADA  
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## Spectra history



## Change history

In the case of change monitoring, the new image is compared to the previous one and data are processed and presented by the special plug-in application, that (similarly to ground cover) can be brought up by pressing on the “resource selector” button. The user interface for the change detection shows enlarged area with change spots marked, and has an option to review the history of changes for the monitored area graphically and as visual or printed report, which may also be automatically mailed through standard e-mail interface of the underlying M2C application.



### Change detection

In general terms any object can carry unlimited number of external resource references, and if more than one is available the operator has to pick the option of interest from the selector menu, that appears after clicking on the “resource selector” button.

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