REMOTE SENSING METHODS IN THE IDENTIFICATION OF OIL CONTAMINATIONS

MOŽNOSTI VYUŽITÍ VYBRANÝCH METOD DPZ PRO IDENTIFIKACI ROPNÝCH KONTAMINACÍ (STARÝCH EKOLOGICKÝCH ZÁTĚŽÍ)

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Abstract

The article deals with the possibilities of using remote sensing methods for analysis, observation and identification of old ecological hazards caused by petroleum contaminations from insufficiently plugged and abandoned oil wells in the area of Hodonín. It is focused on the description and determination of areas of interests, remote sensing approaches to the problems of petroleum substance detection and establishing the methodology of an acquired data analysis. Moreover, proper methods, algorithms and satellite digital data parameters for this aim are discussed. The article also describes in-situ measurements, technical instruments and further research advancements. Finally, the proposals of the results evaluation, interpretation and complex comparisons with the results of past and future researches in the area of Nesyt - Hodonín are specified.

Abstrakt

V príspevku autori informujú o možnostiach využitia vybraných metód diaľkového prieskumu Zeme (DPZ) pre sledovanie, analýzy a identifikovanie starých ekologických záťaží spôsobených ropnými kontamináciami z nedostatočne zlikvidovaných ropných vrtov a sond na Hodonínsku. Zaoberajú sa popisom a vymedzením sledovaných lokalít, prístupmi DPZ k problematike detekcie ropných látok a navrhovanou metodikou vyhodnotenia zozbieraných vstupných dát. Ďalej sú diskutované metódy vhodné pre tento účel a taktiež parametre družicových dát. Opisované sú terénne experimenty, využitá technika a ďalšie smerovanie aktivít výskumu. Na záver sú spomenuté návrhy na využitie a komplexnejšie porovnanie výsledkov s už prebehnutými resp. plánovanými výskumami v oblastiach Nesytu - Hodonína.

Key words: remote sensing, oil contaminations, hydrocarbon detection, hydrocarbon index

1 INTRODUCTION

Remote sensing methods and technologies offer a wide range of analytical tools and techniques applicable in various Earth sciences. In the field of petroleum production, these methods can be used not only for supporting the exploration but also in plug and abandon (p&a) and sanitation processes. Acquiring data remotely by using hyperspectral airborne or satellite sensors and applying suitable analytical and classification algorithms allows effective and progressive solutions for specified tasks.

This article deals with the recent issues of selected remote sensing methods for detection, analysis and classification of areas with oil contaminations (or oil seeps). Oil and gas seeps caused by (gas/oil) pipeline accidents, p&a processes, sanitation of oil well in the past contaminated bedrocks, soils, aquifers and vegetation. This research focuses on the utilization of remote sensing methods for an analysis of potential environmental stress caused by oil contaminations which originated during oil wells p&a and sanitation operations in the area of the town of Hodonín in the last century. By now a comprehensive search of remote sensing algorithms used for mentioned purposes was realized. Only those approaches were selected which could be applied under our geographical conditions. It was followed by basic verifications of chosen methods, in some cases the methods were accommodated to the analyzed area and satellite data types. Enrichment of the set of input data with the in-situ data acquired by using terrain spectrometry allows a wider range of remote sensing methods application.

2 STUDY AREA

On the basis of specific requirements set by the MND Company and the results of previous projects, two areas located in the South Moravian Region were chosen for the research. The first one is located in a part of the town of Hodonín called Nesyt (48°50′15′′ N, 17°06′07′′ E) and the other one is a suburb of Břeclav called Poštorná. First reconnaissance of the terrain was done. By using the GPS Trimble GeoHX station some points of interests were measured in both locations. Up to now all the activities have been realized in the area of Nesyt. After acquiring results in this area it is anticipated to relocate the activities to the area of Poštorná.

3.1 Area of Hodonín- Nesyt

One of the areas of interest is located in the south-west part of the town of Hodonín, next to a waste water treatment plant, along the right bank of the Morava River. The first activities related to oil and gas exploration and drilling started here already at the beginning of the 20th century (in 1919). Together with the worldwide technology progress also new, tentative and less destructive exploration and drilling methods were developed. Despite of this, the liquidation and p&a processes of old wells are still complicated (due to absence of documentation concerning the primary stage, reconstructions and reparation of the wells). It is assumed, by virtue of the facts, there is a contamination caused by less-precisely plugged wells and also a threat of contamination of bedrock, groundwater, agriculture soil and surrounding ecosystems is still present.

Fig. 1 shows the ortophotomap of the area of Nesyt (yellow line represents the state border situated along the Morava River). Fig. 4 shows the photography of one part of the area of interest (arable land lined with permanent crops) captured during the terrain reconnaissance in May 2010.

Fig. 1 Location of the area of interest called Nesyt [13]

3 REMOTE SENSING APPROACH IN HYDROCARBON DETECTION

Deeper progress in the utilization of remote sensing methods in the analysis of hydrocarbons started in the 1970's (for example the research in the Anadarko Basin in the USA in 1973) when the Landsat technology was applied. The aim of the research [2] was to observe faults and lineaments. In 1977 the method for using the microwave energy within the remote sensing method for detecting gas seeps on the surface was patented. Later on, in 1984, it was followed by another patent for infrared remote sensor.

3.1 Oil seeps and contaminations

A hydrocarbon seepage can produce the indices of migrating oil paths along which oil pressured by a lifting force of a subsurface origin, migrates. Rubio in the study [8] of oil seeps defines the oil seep as a result of hydrocarbon migration along faults, joints and sites of discontinuities, perforations and rock pores. Macro oil seeps are visible, located in the small areas. On the contrary, micro oil seeps form low hydrocarbon concentrations in shallow sediments. Their presence is indicated by geochemical changes in the bedrock and minerals, and by vegetation stress. Oil slick (contaminations caused by human activities) could be observed in the areas of geohazards (e.g. plug and abandon wells). A potential leakage can occur out of the basic collector and endanger the bedrock and aquifers (also quality of groundwater).

3.2 Spectral characteristics

For every mineral, rock or any chemical change occurrence on the surface it is important to analyze only narrow intervals of the electromagnetic spectrum. The aim is to search typical shapes of curves in the selected intervals and to determine absorption bands (maximums or minimums in absorption).

The ultraviolet part of the spectrum is interesting for geological applications. A problem is the intensive absorption of UV radiation in the atmosphere – only a small part penetrates through. In the UV part of the spectrum, it is possible to observe the fluorescence of hydrocarbons. The presence of hydrocarbons is analyzed also in the SWIR (Short Wave InfraRed interval of the electromagnetic spectrum). While observing thermal anomalies it is possible to detect oil leaks. The microwave part of the electromagnetic spectrum is in particular important in the analysis of sea level observation of oil leaks from offshore drilling rigs and during the transportation of hydrocarbons. But the ongoing research does not deal with the possibilities of radar data (microwave part) analysis methods. It focuses on optical hyperspectral image data. The background research and the basis of initial verification of sample data resulted in the fact that the most important intervals of the electromagnetic spectrum in which the absorbing bands of hydrocarbons are located (we observe the so-called hydrocarbon feature as in Fig. 2), are the 2.31 – 2.35 μm interval (verified in East Hebei, India [9]) and the spectrum interval of approximately 1.73 μm (approved by using the airborne hyperspectral scanner HyMap [3]).

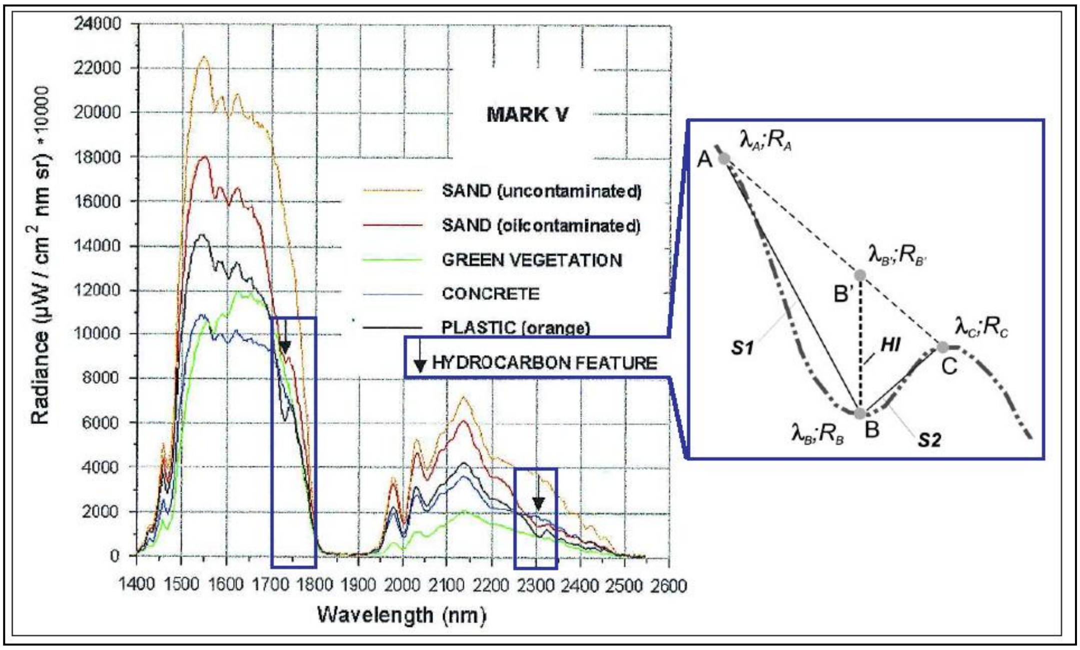

Fig. 2 An example of spectral signatures with highlighted intervals of "hydrocarbon feature" [3]

3.3 Input satellite data

After the first review of particular parameters of remote sensing scanners and sensors operating and acquiring the data for scientific and commercial purposes, the sensors Aster and Hyperion were chosen for initial verifications of selected algorithms. The image scenes acquired by both sensors were used to test the suitability of selected remote sensing approaches for the hydrocarbon detection. The selection of proper data was made with the support of a Czech distribution company by using the Glovis tool (created by the U.S. Geological Survey - USGS) and the Eloisa Tool (operated by the European Space Agency - ESA). Further analysis will be performed by using the ENVI software.

The ASTER sensor (installed on the Terra satellite) provides data in high spatial resolution and suitable spectral resolution. The ASTER scenes cover regions of 60 x 60 km and the spectral resolution of the scanner is appropriate (spectrum interval of 2.3 μm). The problem of this sensor is that it is in operation more than 10 years and as a consequence the technical conditions and the quality of data acquisition are getting worse and since 1st April 2008 the SWIR detector has been out-of order. The sensor Hyperion provides data with spectral resolution between 0.356 μm and 2.677 μm, spatial resolution of 30 m and the FWHM (Full width at half maximum) from 0.0104 μm to 0.0116 μm. A digital image contains 242 bands out of which 44 are non-calibrated because of decreasing sensitivity of detectors. 198 bands cover the spectral region between 0.426 μm and 2.395 μm. The data acquisition is performed by two spectrometers: one in the visible near infrared part and the other in the short wave infrared part. Hyperion provides scientific data utilizable in the determination of land characteristics and hydrocarbon substances detections. The hyperspectral sensor Hyperion uses the pushbroom type of spectrometer. This pushbroom technology uses a 2D CCD detector located in the focal area of the sensor. The phenomenon of vertical striping was observed in the testing data of the sensor. It is caused by small variations during the sensor calibration, movements of the focal plane and outside temperature. This phenomenon usually occurs in the pushbroom types of sensor. Its elimination is a part of the data pre-processing and for this purpose special destriping algorithms are used. In the case of the Hyperion sensor (also of the Ali sensor – both from the EO-1

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satellite) another problem was found. During the last few months the area of interest (the towns of Hodonín and Břeclav) were not scanned and there are no data acquisition from the EO-1 satellite. For these reasons an alternative selection of a satellite data combination for analysis was defined.

In this case, except for the EO-1 sensors (Ali and Hyperion) and the Aster and Modis sensors, it is also possible to use the data from following satellites: IRS-P6v (sensors AWiFS, LISS-III), SPOT 5 (HRG_MS), Landsat 7, Rapid Eye (analyzing „Red-Edge" phenomenon). The proposed time resolution of the data is the period of year after snow-melting and the period with vegetation in spring and autumn. The desired level of pre-processing is the data applied with geometric and radiometric corrections and also the data georeferenced in the coordinate system WGS84 (UTM33/34 projection). The spatial resolution should be in high or very high quality – but this requirement has a lower priority comparing to the requirements for the spectral resolution.

4 ESTABILISHED METHODOLOGY OF DATA ANALYSIS

The algorithms and methods shown in the diagram (in Fig. 3) are used in the analytical and classification phase of the data analysis. Data pre-processing, transformation and filtration are followed by other processes - by those shown in the diagram. During this data preparation phase standard approaches of remote sensing data pre-processing are applied. In the following paragraphs some of them are described in more detail.

4.1 Data pre-processing

The aim of data pre-processing is to apply geometric and radiometric corrections. The geometric corrections transform the coordinate system of digital images or the pixel size. The radiometric corrections adjust the digital numbers of the pixels. Moreover, atmospheric corrections are applied with the aim of gathering the absolute reflection values of several types of surfaces. The software tool ENVI for applying required atmospheric processes contains the FLAASH module (uses MODTRAN model for the atmospheric corrections). In the case of absence of the input information necessary for the use of the FLAASH module, it is possible to apply the IARR (Internal Average Relative Reflectance) method, also integrated into the ENVI tool.

4.2 Selection of proper methods (Hydrocarbon Indexes, Red Edge, Spectral Matching)

During the visual analysis of digital data the aim is to identify the objects of interests and study their specific colour, shapes, size, texture, shadows and the vicinity associations. The false-color compositions permit to observe the digital images visually. For example, while building the colour (RGB) composition using the ASTER band No.3 as red, band No.2 as green and the band No.1 as blue, it is possible to observe and study geologic faults and lineaments. Before the visual analysis can continue, few data preparation steps have to be done (like sharpening the contrast, etc.). An appropriate combination of the data acquired by the airborne hyperspectral sensor HyMap was created in the German research [5] of hydrocarbons. The bands with the wavelength 1.668 µm as red, 1.729 µm as green and 1.788 µm as blue were used as the input for the false-colour combination suitable for studying and analyzing hydrocarbon substances.

In this research, various methods for the data analysis were chosen. One of them is the method for classifying the petroleum-influenced (contaminated) vegetation located in the testing areas and applying the algorithm for the shift in the "Red-Edge" part of the electromagnetic spectrum. Before the application of this method, it is necessary to classify the vegetation in the area of interest. The vegetation growing in potentially contaminated soils could be damaged – vegetation stress occurs. One of the typical spectral characteristic of stressed vegetation is the shift of the Red-Edge position. The Red-Edge is the name given to the abrupt reflectance change in the 0.680-0.740 µm regions of the vegetation spectrum that is caused by combined effects of strong chlorophyll absorption and leaf internal scattering [1].

That affects the Red Edge position shift towards shorter wave-lengths. Noomen in his specific research [6] focuses on the vegetation stress along petroleum pipelines. Noomen's greenhouse experiments were followed by the terrain practice. Except gas concentration measurements also heights of plants were measured in both experiments. They expected that the short plants would be more stressed and their Red Edge position would be localized in shorter wavelengths comparing to "clean" plants. This hypothesis and the results of greenhouse and in-situ experiments were verified in this research by using the remote sensing approach. The sensor Probe-1 and one digital image of the ASTER sensor were used for the analysis. Depending on the imagery availability, the described approach might be applied also on the potentially contaminated vegetation in the area of Nesyt, Hodonín.

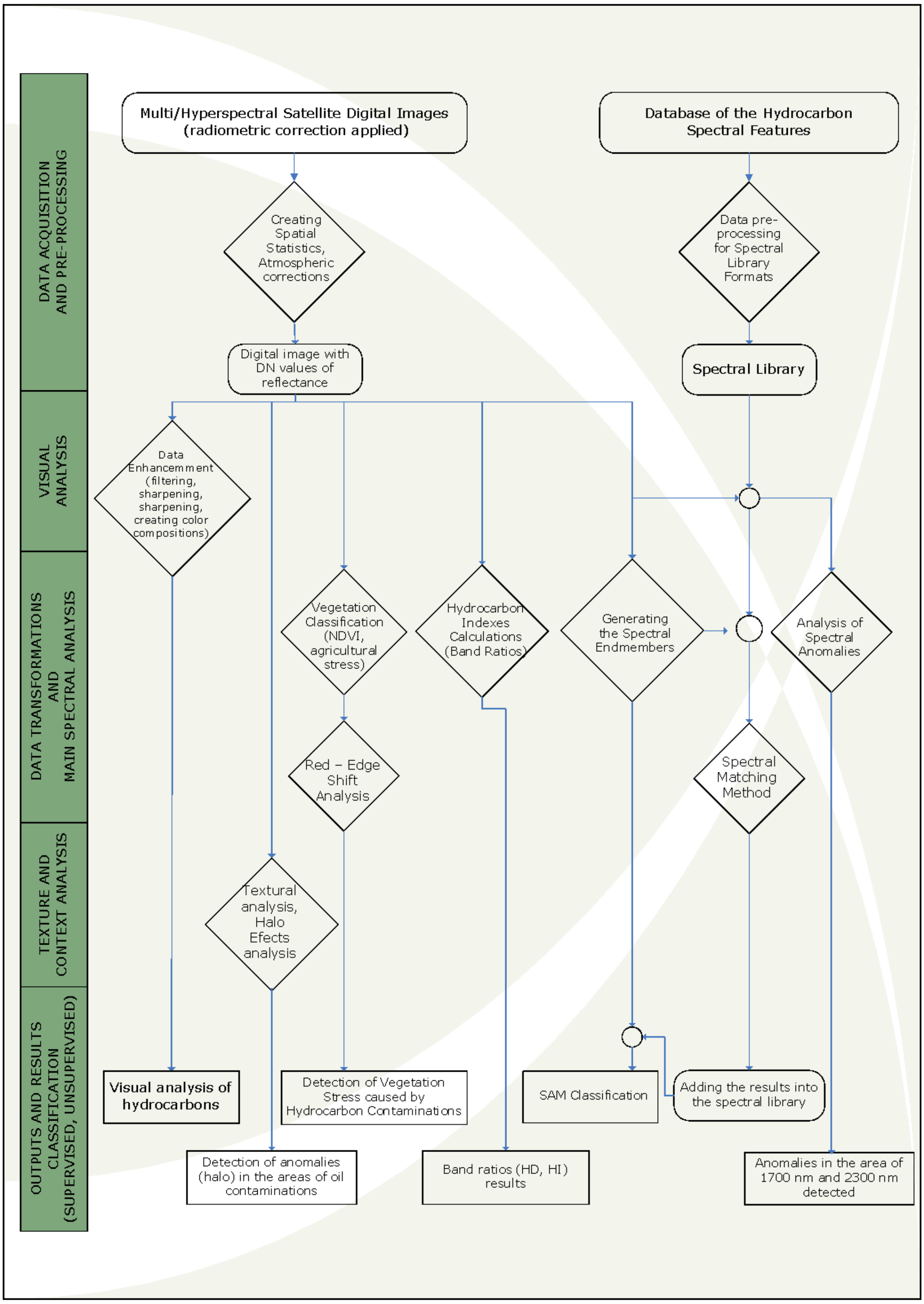

Fig. 3: Proposed methodology of data analysis, using the ENVI SW tool [15]

The remote sensing approach in geological applications often utilizes a lot of complex band ratios and computations of indexes (ratio with a great number of image bands) for the presentation of spectral contrasts of typical absorption features. In the area of petroleum contamination detection, two principal approaches to band ratios computations were studied: the hydrocarbon detection (HD) and hydrocarbon index (HI) computation.

In the first analysis, using ASTER digital images from the area of the Ventura basin in California (with the noted presence of a hydrocarbon seepage), the calculations of HD were performed – several bands of digital images matched with the bands required by the HD calculation formulas. The applied formula is HD= (A+C)/2B (if HD>1 the indices of hydrocarbons are detected, A band =2.297 μm, B band =2.313 μm, C band=2.329 μm

[12]). Based on the result of band math (HD ratio calculations) the filter 3x3 for data smoothing was applied. As the final result, a composition of the following layers was generated for publishing and visualization:

- point vector shape file with located hydrocarbon seepage areas (created according to the results and research by Rubio [8]) ,
- and results of HD calculations.

The correspondence of the layers in the composition was proved, matching successfully the known results of the research by Rubio (supported also by in-situ measurements) with the outputs from the HD calculations.

The other approach deals with the Hydrocarbon Index (HI). It was defined and used in the German research [5] using digital images acquired during airborne data acquisition with a hyperspectral HyMap scanner. The hydrocarbon spectral features were observed in approximately 1.73 µm (interval) of the electromagnetic spectrum. In this part of the EM spectrum, we observe a minimum of spectral characteristics for a sand surface with a petroleum contamination. The curve looks like the letter "V". The absorption is not distinctive but evident. The hydrocarbon index uses the vertical line HI=BB´ (showed in Fig. 2) to confirm the presence (indices) of hydrocarbon substances. If the petroleum-affected or contaminated surfaces are present in the surveyed area, the index points A, B, and C form a triangle and the HI>0. There is a direct proportion between HI and the quantity of petroleum substances.

The hydrocarbon index is calculated using the following formula [5]:

$$HI = (\lambda_A - \lambda_B) \cdot \frac{R_C - R_A}{\lambda_C - \lambda_A} + R_A - R_B$$

R_A, R_B and R_C are the values of spectral reflectance at the wavelengths λ_A, λ_B and λ_C for the index points. As A band the wavelength 1.705 µm, as B 1.729 µm and as C band 1.741 µm were set. The result of the research [5] was the detection of hydrocarbons. The advantage of this approach is its utilization with the data without any complex applications of atmospheric corrections. It is better to use the data with a higher signal-to-noise ratio.

Moreover, yet another method was applied to the data - a spectral matching method (a comparison of the spectral features gained during the Hyperion data analysis). These typical reference spectral features can be used as an input to other classification algorithms. On the basis of the false-colour composition results (emphasizing the hydrocarbon-affected areas with purple colour) the spectral curves (features) were generated and visualized in several charts. Matching these typical curves (values at the wavelengths on the x-axis and radiance values on the y-axis and the curves from the hydrocarbon spectral library) the similarity in the curve trajectory was confirmed.

5 IN-SITU MEASUREMENTS

In-situ measurements were conducted in the area of Hodonín – Nesyt town part. The first terrain survey and the first measuring trials with a terrain spectrometer were performed. The methodology for next examinations and steps was prepared.

Fig. 4: Terrain survey-area of Nesyt [14]

Fig. 5: CropScan terrain spectrometer [14]

5.1 Technical instruments

The Field Multispectral Radiometer (Cropscan MSR16R type) was loaned from the Institute of Landscape Ecology of Slovak Academy of Sciences and all its components are shown in Fig. 4 (scanning and recording unit). The design of the radiometer allows for near simultaneous inputs of voltages representing incident as well as reflected irradiation. This feature permits accurate measurements of reflectance when sun angles or sunlight conditions are less than ideal. Useful readings may even be obtained under cloudy conditions. The MSR16R model contains 16 sensors covering the region of the EM spectrum from 0.450 to 1.75 μm. Cropscan provides the DLR interface (multichannel Data Logger Controller), which communicates with laptops or PCs via a RS-232 I/O port. The measurements are being realized by moving the instrument from point to point in the monitored area. Depending on the height of the scanning unit (installed on the scanning wand approximately 2 m long) the scanners could record and capture various size of the surface. The field of view of the multispectral sensors for the reflection measurements is 28 degrees. The range of operative temperature is 0-50°C.

Each type of the surface emits, absorbs or reflects the electromagnetic radiation depending on its specific characteristics. The field spectrometer acquires the amount (rate) of radiation in selected wavelengths. The Cropscan system operates in the visible and near infra-red region of the EM spectrum. The system consists of a radiometer, DLC or A/D converter, terminal, telescopic wand, connectors and an operating system. The system operates by converting incoming or reflected irradiation to a millivolt signal for a subsequent analog-to-digital (A/D) measurement conversion and storage by the Data Logger Controller (DLC).

The use of the radiometer is based on the assumption that the irradiance flux density incident on the upward facing sensors is equal to the irradiance flux density incident on the target surface. This is a valid assumption when the radiometer is used in sunlight, where the source of light is a long distance from both the radiometer and the target surface. It is assumed that the surface from which the reflectance is to be measured exhibits lambertian reflectance properties. A lambertian surface is one for which the reflected radiance is isotropic with the same intensity for all directions regardless of how it is irradiated. The radiant intensity of the reflected irradiance from a lambertian surface varies with the cosine of the angle of incidence of the irradiance [11]. The use of glass covers keeps the sensors clear. The cosine properties for both upward and downward sensors allow Cropscan to inherently correct varying angles of irradiance. The cosine diffusing property of the opal glass, though not perfect, is quite good in the visible and Near Infra-Red (NIR) regions. Silicon photodiodes are used for 0.460 to 1.00 μm wavelength sensors and germanium photodiodes are used from 1.00 μm to 1.65 μm. Fig. 6 shows the range of MSR16R bands.

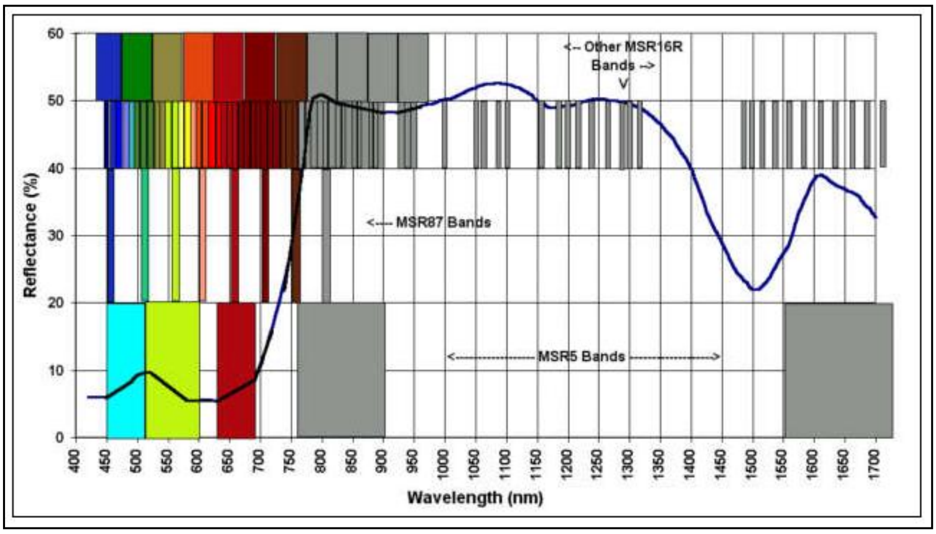

Fig. 6: Intervals of electromagnetic spectrum covered by Cropscan instruments [11]

5.2 Terrain measurements

During the terrain measurements the scanning part of the instrument is placed on the telescopic wand. The diameter of the field of view equals one half of the Cropscan scanning unit height above the terrain over the target. An additional function is the averaging of several measured samples. The system is logging the ID of the measurement, acquiring the time and temperature and the level of sun radiation (illumination). Every scan done with a trigger switch is running for approx. 4 seconds. Convenient results could be obtained also during the light cloudy weather (cirrus or light stratus clouds). The best results are obtained under clear weather conditions, therefore this fact determines the days when the in-situ measurements could be performed. On the display of the recording unit values of illuminations are shown (optimum is 400). The results of the measurements are processed through a graphical interface, not so user friendly. The first step is the data import through a serial port to the PC and afterwards performing the preprocessing steps. This contains transformation of native formats *.mv – milivolt file, *.cmr – corrected milivolt file to *.rfl – percent reflectance file and *.irr - radiometric irr file and final exports to the table *.xls formats suitable for further analysis.

After initial reconnaissance of the terrain in the area of Nesyt characteristics of the area were created on the basis of available geological, hydrogeological and pedological parameters of the terrain. During March and April 2010 the preparations of technical devices (instrument calibrations) and the testing measurements outside the area of interests were proceeded. In-situ measurements and observations were performed during May, June and August 2010. The next phase consists of processing terrain results and creating spectral characteristics of typical surfaces of the Nesyt area. For autumn 2011, supplementary measurements in the location of the village of Korňa (in Slovakia) are planned, because near this village a natural oil seep can be found (Fig. 7).

Fig. 7: Naturally occurring hydrocarbon seepage located in the north of Slovakia – Korňa village [14]

6 PROPOSAL OF RESULTS EVALUATION AND INTERPRETATION

The outputs and results of the in-situ measurements will be processed into a format suitable for importing to the ENVI software tool. The image processing and classifications run in the same SW tool.

6.1 Comparisons

Except the analysis and classification of satellite data, it is possible to proceed with further validations and comparisons of the results. In the past, various researches concerning the surface and subsurface contaminations in the areas of Nesyt, were performed. The researches and studies were focused on the investigation of potential contaminations, characteristics of the contaminations, their spatial distributions and surface monitoring. One planned part of the final phase of the research discussed in this article is the comparison with the available results of previous researches. For the comparisons various overlay operations are assumed. Probably there would be a need to transform some of the results to process the comparison correctly and to interpret and visualize the results and outputs properly.

At the Institute of Geological Engineering (Department of Applied Geology) of the VŠB - Technical University of Ostrava some series of geophysical measurements are being prepared. The project is to apply a ground penetrating radar (GPR, delivered by Mala Company). At a certain level, the results of geophysical radar measurements could be compared to the above mentioned research and complex comparisons could be made.

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7 CONCLUSIONS AND OUTLOOK

The article elaborates the issue of the current state of work dealing with a remote sensing analysis in the areas of the South Moravian region where old oil contaminations are potentially located. The remote sensing approach brings a lot of advantages in the oil and gas substances analysis. Selected classification algorithms were in some cases adapted and modified to the area of interest and available digital images. The absence of terrain data (acquired during in-situ measurements) limits the application of a whole set of applicable methods. Therefore, the results from in-situ measurements in the Hodonín area are applied as the inputs to further analysis. With the aim of testing the accuracy of selected classification algorithms, the first practical part of the work was focused on the areas where the occurrence of hydrocarbons (petroleum contaminations) is known and evincible. The selection of testing area in an arid climatic region depended on the presence of oil and gas reservoirs of the Middle East. The occurrence of petroleum in these areas is obvious. The area of interest in a humid region was chosen based on the results of a research ITC group. The detection of oil seeps was done in various researches in the area of Ventura Basin, California. Because of lack of subsidiary data (gathered for example during in-situ measurements), the selection of tested algorithms was reduced. A large part of work was focused on the data pre-processing. For this purpose and also for verification of chosen methods, the ENVI software tool was most frequently utilized. False-colour composition of selected Hyperion hyperspectral bands produced the results. From the emphasized hydrocarbon areas, the spectral curves (features) have been created and their absorption minimums of the curves corresponded with the absorption minimums and shapes of the spectral features gained from the reference spectral library. Another utilized algorithm was the computation of the hydrocarbon detection index in the area of the Ventura Basin. The comparison of the results with the evincible and known occurrence of hydrocarbons proved the accuracy of the detection. Applications of another hydrocarbon index to the Hyperion digital images from the area of Kuwait did not produce desired results. The problem was most likely in the quality of input digital images data (vertical striping). Based on the created methodology further activities in the area of Nesyt are still being executed.

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[15] Author according to the ENVI SW tool documentation

RESUMÉ

Príspevok sa zaoberá popisom stavu analýz území s ropnými kontamináciami v oblastiach Južnej Moravy, pri ktorých sú využívané technológie diaľkového prieskumu Zeme (DPZ). DPZ poskytuje radu výhod pri skúmaní zemského povrchu s cieľom detekcie uhľovodíkov. V oblasti ťažby ropy a zemného plynu môžu metódy diaľkového prieskumu Zeme určitým spôsobom podporovať nielen exploráciu, ale aj likvidačné a sanačné fázy. Snímaním terénu na diaľku pomocou hyperspektrálnych leteckých alebo družicových senzorov a aplikáciou vhodných analytických a klasifikačných algoritmov na získané dáta je možné efektívnym a pokrokovým spôsobom riešiť viaceré nastolené úlohy. V príspevku je opisovaný stav riešenia problematiky využitia vybraných metód DPZ pre detekciu, analýzu a klasifikáciu území s ropnými kontamináciami (alebo aj presakmi). Úniky uhľovodíkov spôsobené haváriami na produktovodoch, likvidáciami (nedokonalými likvidáciami), sanáciami ropných vrtov a sond v minulosti, kontaminujú horninové a pôdne prostredie, podzemnú vodu a rastlinstvo. Popisovaný výskum je sústredený na využitie metód DPZ pre analýzu potenciálnych starých environmentálnych záťaží spôsobených ropnými kontamináciami pri likvidácií ropných sond na Hodonínsku v minulom storočí. Doposiaľ prebehla komplexná rešerš metód DPZ, ktoré sa k spomínanému účelu používajú. Po preštudovaní jednotlivých prístupov boli vybrané predovšetkým tie, u ktorých je predpoklad aplikácie v našich zemepisných šírkach. Vybrané klasifikačné algoritmy boli v niektorých prípadoch upravené a prispôsobené analyzovanej oblasti a druhu používaným družicových dát. Určité obmedzenia pri aplikácii vybraných metód boli spôsobené absenciou podporných dát- dát z terénneho prieskumu. Nasledovalo základné otestovanie vybraných metód, v niektorých prípadoch prispôsobenie prístupov analyzovanej oblasti a druhu použitých družicových dát. Obohatenie vstupných údajov o dáta získané meraním in-situ prenosným spektrometrom potenciálne rozšíri možnosti využitia metód DPZ. V aktuálne rozpracovaných analýzach na Hodonínsku prebieha rozšírenie vstupných dát o údaje z terénneho merania.

L´article décrit des analyses des territoires avec des contaminations pétrolières dans les régions de la Moravie du sud et la télédétection y utilisée. Les méthodes de la télédétection offrent de nombreux avantages en examinant de la surface du globe pour détecter des hydrocarbures. Des méthodes de télédétection dans le domaine de l´extraction du pétrole et du gaz ne peuvent appuyer que l´exploration mais aussi des phases de suppression et d´assainissement. La solution progressive des projets peut se faire par l´enregistrement du terrain à l´aide des senseurs aériens ou satellite et avec l´application des algorithmes analytiques et de classement bien choisis. L´article décrit la solution de l´utilisation des méthodes choisies pour la détection, analyse et classification des terrains des contaminations pétrolières. Des fuites des hydrocarbures provoquées par des accidents, de la suppression incomplète, de l´assainissement des puits de pétrole contaminent la roche et le sol, l´eau et la flore. La recherche est basée sur l´utilisation des méthodes de la télédétection pour analyser de vieilles charges environnementales causées par des contaminations pétrolières au cours de la liquidation des sondes pétrolières dans la région de Hodonín au siècle passé. Les méthodes choisies peuvent être appliquées dans nos latitudes. Quelques algorithmes de classement ont été adaptés pour le domaine analysé. L´application des méthodes choisies ont été limitée par le manque de données de la recherche de terrain. Les méthodes choisies ont été testées et adaptées suivant le domaine analysé et les données satellites utilisées. Les données reçues pendant le mesurage avec le spectromètre portable enrichiront les méthodes de l´utilisation la télédétection. Des analyses dans la région de Hodonín sont en cours et le mesurage dans le terrain continu.