A data mining approach to post disaster assessment of 2008 floods in Romania

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ABSTRACT

This paper demonstrates the performance of a rapid mapping kind of approach considering knowledge discovery from Earth Observation images, to provide information support during response and immediate post-response by delivering products emphasizing the extent and impact of the event, by event understanding any type of natural or man made disaster.

Knowledge discovery from Earth Observation images implies mapping low level descriptors (primitive features) extracted from the image into semantic classes in order to provide an interactive method for effective image information mining. In the frame of information theory a communication channel is considered between remote sensing imagery and the user who receive existing information in the data sources, coded as image semantic content. This channel has three components - Data Source Model Generation, Query and Data Mining. Data Source Model Generation uses image content analysis to generate a set of scene's content descriptors. Further, the Query component involves the user and performs an image retrieval based on image content as query parameter. The query component relies on the Support Vector Machine classifier which is able to group descriptors into relevant semantic classes. The classifier supports rapid mapping scenarios and interactive mapping. The proposed concept is illustrated analyzing Earth Observation images acquired post (SPOT 4 and TerraSAR-X) floods disaster in Romania at the end of July 2008. Hundreds of towns and villages were affected and more than 20,000 people evacuated. The northeastern region of Romania was declared back then national disaster area. The results includes potentially flood affected areas detected on 28 of July, detailed semantic classes for rapid mapping and a quantitative evaluation of damages.

A validation procedure is considered, taking into account rapid mapping products delivered by Romanian Space Agency (ROSA) and SERTIT (SErvice Régional de Traitementd'Image et de Télédétection).

DESCRIPTION OF THE EVENT

Thousands of people were evacuated in northeastern Romania after heavy rains caused massive flooding that swept away homes, cut off electricity and damaged roads. At least four people died and two people are still missing.

After days of heavy rain at the end July around the Carpathian Mountains, floods have hit western and southern Ukraine with rivers, including the Dniestr and the Prut Rivers, bursting their banks. The floods are the worst seen in a century, leading the government to declare the region a national disaster area. Hundreds of towns and villages are affected with more than 40,000 houses affected and some 20,000 people evacuated. The government had declared red code concerning the water debit for several major rivers like PRUT, SIRET and Suceava. Romanian Space Agency in collaboration with the German Aerospace Center DLR prepared and asked the activation of International Charter "Space and Major Disasters".

CLASSIC RAPID MAPPING APPROACH

Rapid Mapping services provides information support during response and immediate post-response by delivering rapid mapping products emphasizing the extent and impact of the event, by event understanding any type of natural or man made disaster. Rapid mapping products are ready to use maps of the event revealing disaster extent, scale and possible impact with overlaid cartographic information.

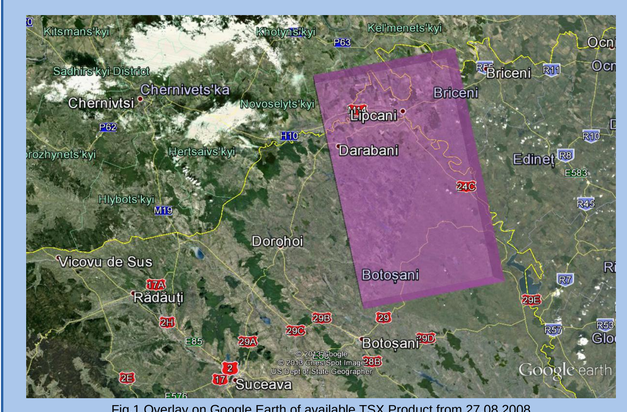


Fig.1 Overlay on Google Earth of available TSX Product from 27.08.2008

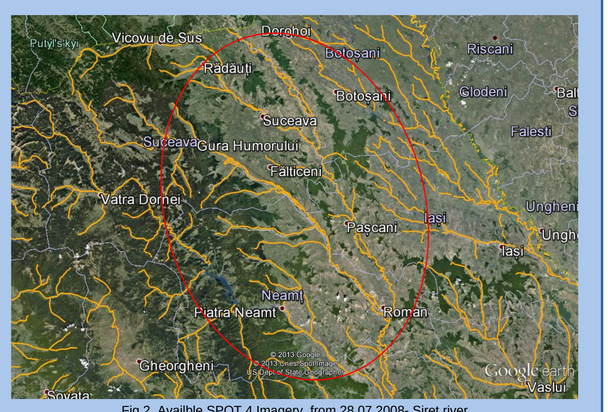


Fig.2 Availble SPOT 4 Imagery from 28.07.2008- Siret river

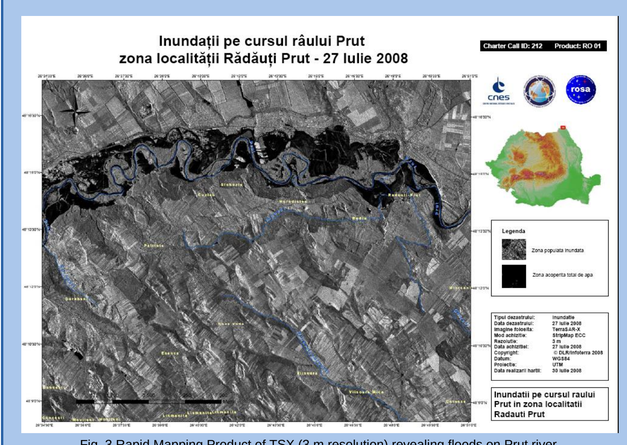


Fig. 3 Rapid Mapping Product of TSX (3 m resolution) revealing floods on Prut river.

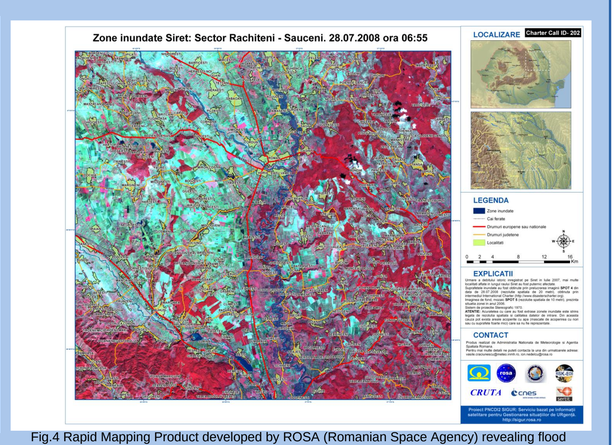


Fig.4 Rapid Mapping Product developed by ROSA (Romanian Space Agency) revealing flood areas on SIRET river.

PROPOSED POST DISASTER SCENARIO IN THE FRAME OF DATA MINING

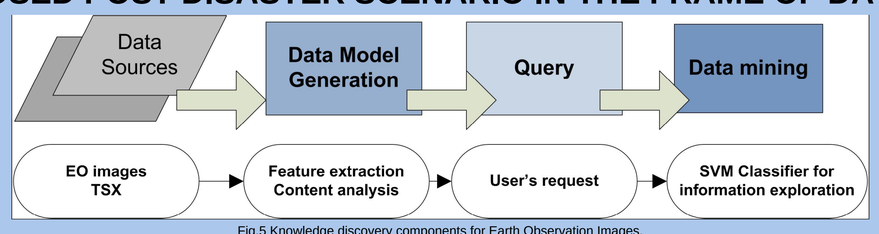


Fig.5 Knowledge discovery components for Earth Observation Images.

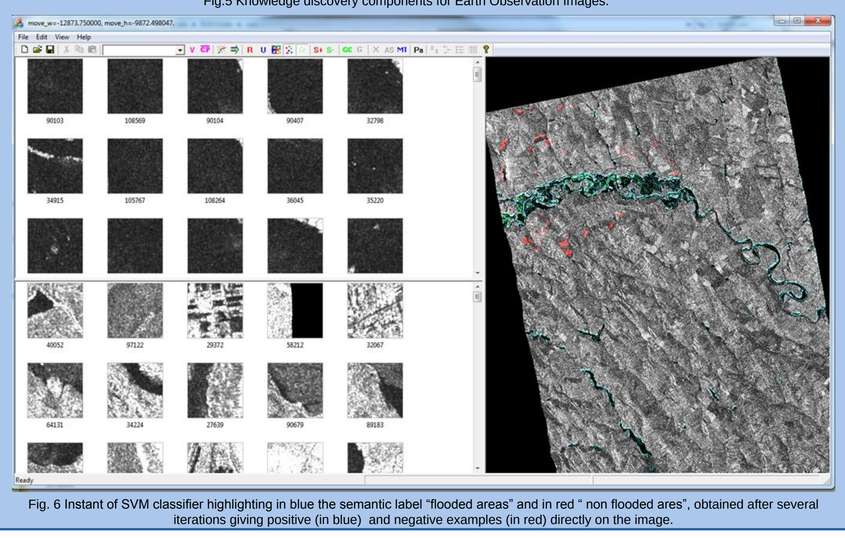
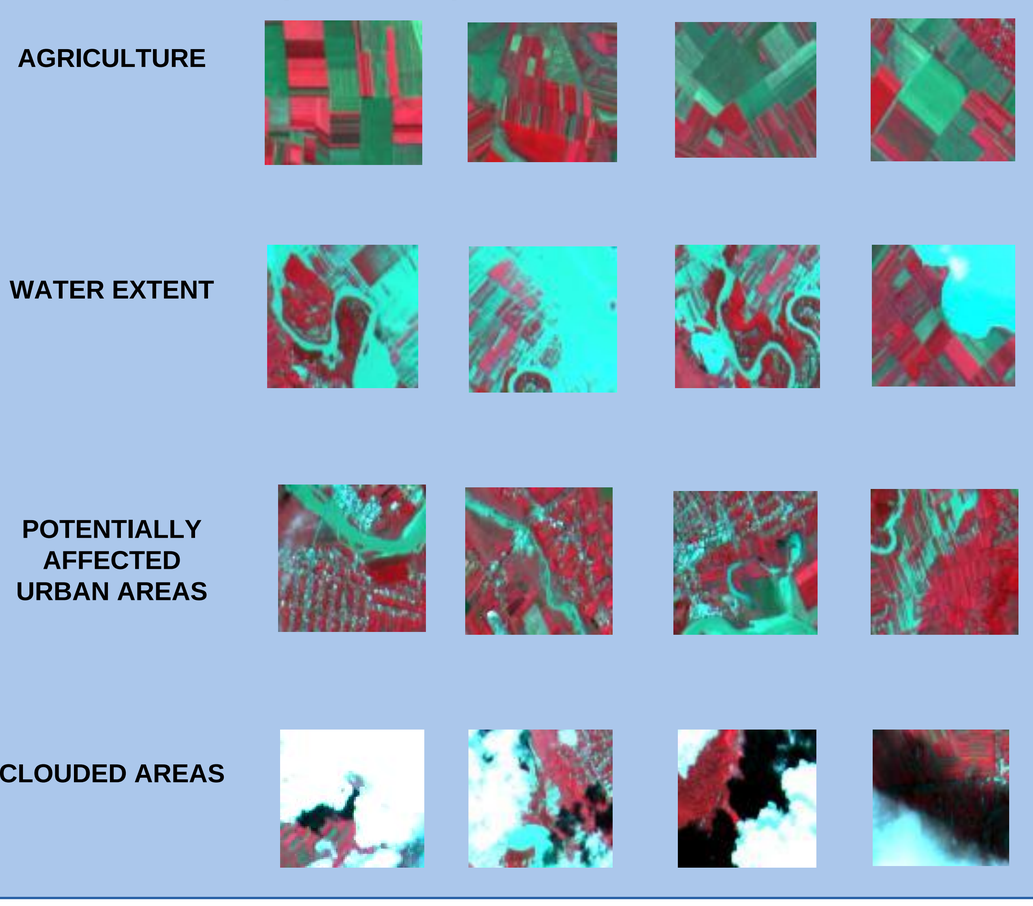
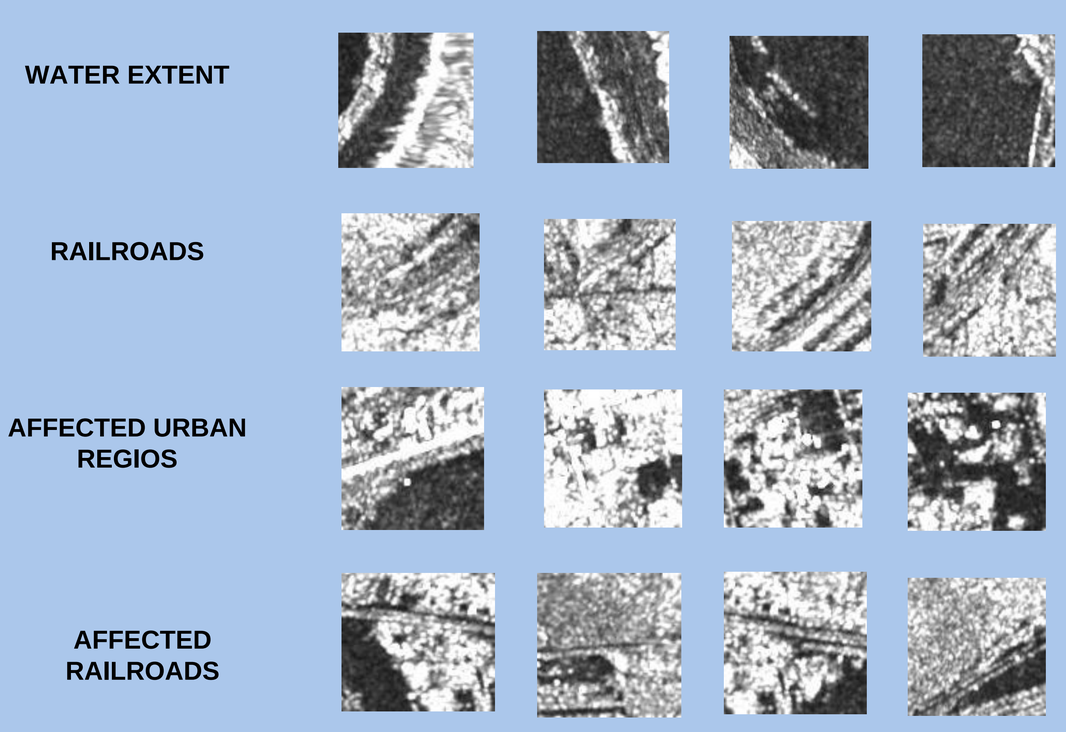


Fig. 6 Instant of SVM classifier highlighting in blue the semantic label "flooded areas" and in red " non flooded ares", obtained after several iterations giving positive (in blue) and negative examples (in red) directly on the image.

SEMNATIC CATEGORIES EXTRACTED FROM SPOT PRODUCT (21.07.2008) ON SIRET RIVER



SEMANTIC CATEGORIES EXTRACTED FROM TSX PRODUCT (21.07.2008) ON PRUT RIVER



CONCLUSIONS

The described scenarios makes used of SVM classifier to generate semantic learning in a Content Base Image Retrieval approach. The results include detailed semantic categories for rapid mapping. Each data mining scenario includes three stages: Data Annotations, Data Query and Quantitative analysis of the results. In the end, based on query results, a semantic map of affected regions can be developed.
In addition to the traditional approach the proposed data mining scenarios result in an effective and precise evaluation of damages thanks to human feedback embedded in the analysis.

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