Using geo-information to track down security risks

The EU's common foreign and security policy is gaining shape, so the Directorate-General for External Relations is setting even more stringent requirements for intelligence and policy support. That is where the G-MOSAIC project, being carried out within the Global Monitoring for Environment and Security programme (GMES Security), comes into play. TNO is one of the partners helping to realise these innovative, largely automated, geo-information products based on selected radar images.

In Torrejon, Spain, incoming satellite images are being very carefully analysed to identify whether any of the activities they contain could be a threat to security. Are natural resources being plundered during a coup in Africa? Is there a leaking oil pipeline in Russia? How are things looking on the European perimeter with regard to illegal immigration? What suspicious or risky activities are occurring in the vicinity of life lines like oil pipelines? Europe has to know what is happening in the world to be able to determine its course, also in respect of crisis management and nuclear activities. In many cases *Torrejon* has to come up with answers to specific questions, fast.

To date this work has been based on the 'manual' visual interpretation of optical satellite images but in the future the people in Torrejon will be supported by radar images that are independent of the weather conditions and whose analysis can be automated to a large extent. One of the parties that has enabled this is TNO, along with the EU Joint Research Centre in the Italian town of Ispra and the German Zentrum für Luft- und Raumfahrt (DLR) based in Munich among others. TNO's Rob Dekker says: 'Since 2007 a new generation of high-resolution radar satellites has been operational. Radar images lend themselves less easily to visual analysis than optical images. But radar can penetrate any cloud – essential when you have to quickly provide answers. It is an active instrument able to regulate its own lighting and it has no problems with the changing shadow intensity of the sun. So radar does enable automatic image processing more easily than optical images do.'

Image of the Haïtian capital Port-au-Prince on 13 January 2010, a day after the devastating earthquake that measured 7.0 on the Richter scale and whose epicentre was 15 km southwest of the city.

SENSOR FUSION

Image processing is done using analysis software. 'Part of this is detecting changes in time, for images over the same area. We had already developed algorithms for this for the ERS and Envisat radar systems of the European Space Agency,' Dekker explains. Sensor fusion – in which optical images, existing maps and elevation models, for instance, play a role – also helps to produce a result that is of high quality and reliability. The optical images therefore help to calibrate and validate the radar images. The software also links the incoming radar information to non-spatial information that is present in population density databases or other relevant indices.

Dekker: 'An example of a crisis situation, like the earthquakes in Haiti and Turkey, make it clear how essential such information is.' The disaster in Haiti was used as a pilot case by TNO in G-MOSAIC. 'After the earthquake there was need for ad-hoc information. We compared archive footage with the post-earthquake images to establish the damage caused. This is important in quickly determining the scale of the disaster. In the longer term you can ascertain from comparing the sets of images, for instance, the budget that will be required for reconstruction. This is the first time that this has been done on the basis of radar.'

A less topical case concerns the illegal felling of trees in Congo. Dekker: 'You can monitor exactly the amount of disappearing forest between specific dates from areas that databases show have no felling concession.' The pre-selection of data by the analysis software boosts productivity tremendously. While the eye of the analyst is indispensable to the final analysis, the software ensures that the eye is not inclined to wander in the direction of less relevant data.

Info: rob.dekker@tno.nl