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The growing impact of satellite data in daily life

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Abstract

Satellite images have a growing role in our daily life. Weather previsions, telecommunications, environmental planning, disaster mitigation and monitoring: these are only some of the fieldworks where space remote sensing data, and related processing techniques, provide extremely useful information to policy/decision makers, scientists, or to the "simple" citizen. The demonstration of the level of attention provided by the International Community to the impact of new technologies and satellite Earth Observation, in particular, onto everyday life is testified by the recent and forthcoming project calls. Horizon 2020, for instance, identified "Societal challenges" and "Science with and for Society" among the main pillars. In sub-themes we may read references to the "Environment", "Secure societies", "Climate changes", and many others, most of which soliciting the use of remote sensing technologies. In such scenario the scientists should be conscious about the capabilities and the implications in applying new technologies. Recent examples might be explanatory. Satellite data properly managed can be used to measure millimetric and/or centimetric movements of buildings and infrastructures. It has been demonstrated how long term monitoring of urban areas detecting pre-collapse deformations might provide useful hints to prevent such dramatic events. Or, in different frameworks, satellite data can be an advanced instrument for intelligence and military purposes. With such premises, ethic issues assume a key role to properly address the use of satellite technologies.

Introduction

The availability of a new generation of remote sensing instruments has definitely changed the impact of Earth Observation tools in daily life. Satellites orbiting around the Earth are able to provide a continuous view of every point of the surface with unprecedented spatial and spectral resolutions. Indeed, either Optical (visible-IR) or SAR (Synthetic Aperture Radar) sensors have now reached submetric resolution (see Figure 1), so that they can identify small object or minimum surface changes. Actually, a large number of Low Orbiting missions (altitude between 450-800 km) is available (see Figure 2).

It is useful to highlight how SAR systems can be operating "all weather and day-night", therefore their use is indipendent on weather condition and on time.

In addition, satellite systems provide the user and the decision maker with a huge fan of informations, ranging from the land use changes to the exploitation of water reservoirs, from the gas/hydrocarbon storage/extraction to the deformation of infrastructures, up to applications in military and security frameworks (see, for instance, the target detection). Stemming from such scenario, it cannot be postponed the need to investigate and discuss legal and ethical implications inherent to the use of satellite instruments (see Slonecker E.T. et al., 1998).

In the following pictures some frameworks have been identified: Humanitarian aid and human rights; Immigration; Intelligence and nuclear experiments. Among the abovementioned applications, it is not difficult to identify those cases where ethical implications are present, thus requesting guidelines that actually are not fully developed and customised. The aim is to provide hints for reflecting on the big impact of satellite technologies in our World.

Figure 1: Worldview 3 (left) example image. Operating at an expected altitude of 617 km, WorldView-3 provides 31 cm panchromatic resolution, 1.24 m multispectral resolution, and 3.7 m short-wave infrared resolution. WorldView-3 has an average revisit time of less than 1 day and is capable of collecting up to 680,000 km² per day. Example of SAR (Right) TerraSAR-X Spotlight Staring image (up per picture, 25 cm spatial resolution) and 1-meter "only" TerraSAR-X (bottom).

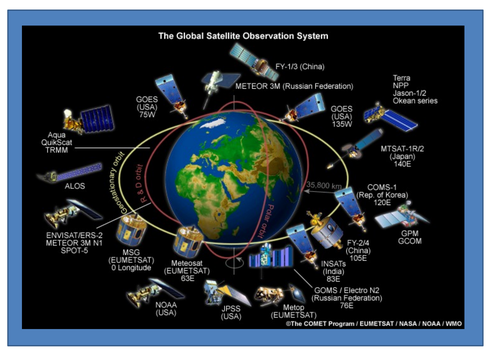

Figure 2: example of commercial Earth Observation satellite missions.

Intelligence and object detection

Several examples of military/intelligence use of satellite images can be simply found. Target recognition, tactical analysis of the scenario for supporting ongoing activities are applications widely diffused in modern conflicts. Recently, SAR images have been used to detect and measure the surface effects due to an underground nuclear test in North Korea not officially declared (Carluccio et al., 2012) (see Figure 6). Such result can have a role, in the near future, in the ban of nuclear tests.

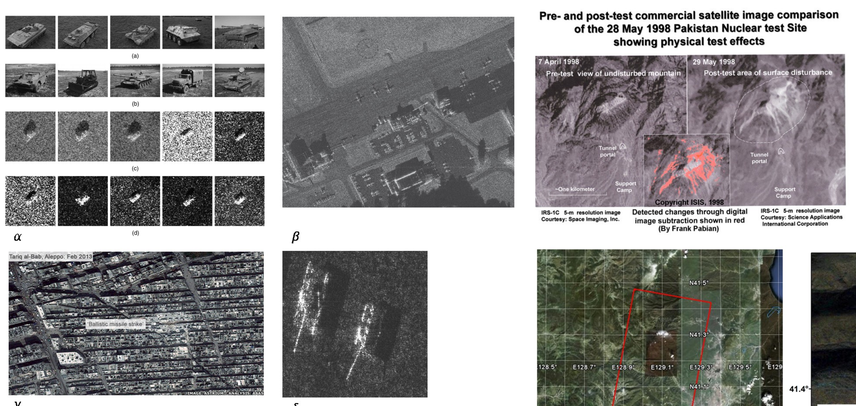

Figure 6: (up) target detection from SAR images and damaged urban areas. (right) effects of underground nuclear tests detected from satellites.

Immigration

The dramatic issue of illegal immigration and refugees has requested the support from satellite images. In particular, the maritime authorities are equipped with specific tools for ship detection that ingest SAR and Optical data that, using specific "morphological" classifiers, identify the boats and their routes (see Figure 5)

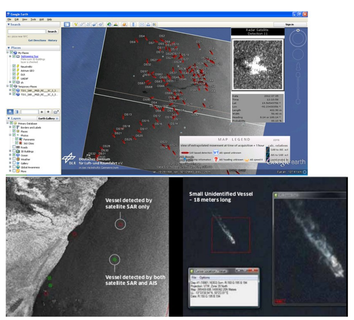

Figure 5: ship detection tool based on SAR and Optical satellite data

Figure 4: pre and post bombing in Damascus. Six months of destructions are pointed out with yellow and red dots (Imagery Copyright: © DigitalGlobe Inc.)

The Citizen in H2020 calls

The role of the citizen and his security is highly emphasized in H2020, the EU Framework Programme for Research and Innovation. In particular, it occurs under the pillar Societal Challenges, the sub-theme Secure societies – Protecting freedom and security of Europe and its citizens (see left picture), that contains some sentences like: "The protection of the European borders requires the development of systems, equipment, tools, processes, and methods for rapid identification." And, going much more to the recent dramatic events: "…new technologies and capabilities for fighting and preventing crime (including cyber-crime), illegal trafficking and terrorism…". The implication of using satellite data and derived products in citizen's life requires a detailed analysis, is quite complex and needs specific law expertise. However some hints can be easily derived from the scenarios we can easily derive from daily chronicles.

Humanitarian aid and human rights

Some examples dealing with the "humanitarian" use of satellites are described below.

UNOSAT is home to an advanced centre of excellence for satellite imagery and data analysis operating since 2001. UNOSAT continues the tradition of high quality map and geospatial data production for UNOSAT ongoing since 2003. In accordance with UNITAR (United Nations Institute for Training And Research) strategic objectives, a geospatial support to to the UN system and other organizations is provided in the areas of:

- disaster response
- humanitarian operations
- human security and the application of international humanitarian law
-human rights

The Satellite Sentinel Project (SSP) and Amnesty International (Eyes on Darfur) have been using imagery to monitor human rights abuses in Sudan and South Sudan since December 2010. Satellite images have (see Figure 3) shown military outposts and troop movements, and provided evidence of mass graves and the destruction of villages. See more athttp://www.satsentinel.org and www.eyesondarfur.org.

Satellite imagery has shown the unlawful demolition of thousands of residential buildings in Damascus and Hama in 2012 and 2013, according to Human Rights Watch. The first satellite image shows the Mezzeh area of Damascus in February 2013. The second image shows the same area in July 2013. The extensive damage over less than six months to these high-rise residential buildings is visible along this main road in the suburb of Syria's capital. The third satellite image shows hundreds of damaged buildings and impact craters following the weeks-long government shelling of a neighborhood in the Syrian city of Homs. This satellite image is overlaid with red circles to show destroyed or damaged buildings and yellow circles to show impact craters in open areas such as fields or roads. Human Rights Watch found that 640 buildings had been visibly damaged and at least 950 craters pocked the area.

Figure 3: Darfur destructions at different times (Imagery Copyright:© DigitalGlobe Inc.)

References

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