SPOT 6 Satellite image, Tunisia. By interpretation of geomorphological, textural and spectral variations, satellite imagery can provide a rich source of information to assist in assessing surface geology ©Airbus DS 2013

ENERGY SAVER

FROM MAPPING AND MODELLING TO PROVIDING COST-EFFECTIVE, LONG-TERM MONITORING SOLUTIONS, SATELLITE IMAGERY IS ADVANCING DECISION-MAKING IN THE OIL AND GAS INDUSTRY BY PROVIDING ACCURATE AND TIMELY INFORMATION. CHLOÉ LECLERC REPORTS

In today's world, oil, gas and mining are among the most challenging industries. Depletion of natural resources, growing demand and global economic pressure points have driven companies to search for new exploration sites and new development projects mainly located in remote and often inaccessible lands and volatile environments.

The latest technological advancements have propelled satellite-based services to the front line of these industries, which has significantly increased the number of potential applications able to support the oil, gas and mining market. They now allow operators to make sound decisions in all typical phases ranging from feasibility, exploration and development to production and final abandonment of a site. Offering a wide range of capabilities, from mapping and modelling to providing cost-effective, long-term monitoring solutions, these applications are advancing decision-making across all these operations by providing accurate and timely information.

Challenges faced by engineers preparing onshore pipeline construction include assessing terrain features such as elevation, buildings and roads as well as cultural landmarks and potential obstacles. One key contributor to understanding these characteristics is using satellite imagery to generate up-to-date land cover maps and digital elevation models. These are effectively 3D topographic representations of the Earth's surface, which as well as being used for exploration can be applied to engineering projects associated with facility and pipeline planning during field development.

Satellites are key to understanding terrain characteristics in a very cost-effective way, thanks to their capacity to rapidly and precisely cover very large areas. The South Caspian pipeline construction by Austria-based ILF Consulting Engineers is a very good example of how fast and accurate space technology can be. The company needed very precise information to calculate which route would guarantee the fastest and the most-effective settlement for a portion of pipeline located in Georgia and Azerbaijan. Due to strong cost and time constraints imposed by the project, a mix of off-the-shelf products, archive data and very high-resolution tasking capabilities were used to fit to the various pipeline routing requirements.

First, a DEM with a vertical accuracy up to 8m (Elevation30) was immediately delivered, together with a seamless orthorectified mosaic derived from SPOT imagery (SPOTMaps with 2.5m resolution), allowing ILF to verify the corridor position, and analyse and correct the pipeline pre-routing thanks to precise 3D information and detailed

land cover knowledge (see Figure 1). Then, 50cm Pléiades archive imagery products were delivered to assess, with better accuracy, the best routing options to determine the most effective pipeline route, taking into account engineering costs and accessibility for staff. The higher level of identifiable detail contained in such imagery, enabled the discrimination of land cover and land use in a more refined way (see Figure 2).

Finally, stereo pairs of Pléiades imagery were collected, and ground control points used to create an Elevation1 digital terrain model (3D representation at 1m posting of the bare Earth – all man-made features and vegetation removed) for in-detail modelling for final analysis and potential re-routing (see Figure 3). For a subset of corridor, 3D vector maps were also extracted.

As a result, a precise and consistent pipeline route was produced, with accuracy far better than the requested specifications for over 80 per cent of the areas checked by ILF Consulting Engineers.

Cost-effective offshore operations

The extensive costs related to offshore activities remain difficult for oil and gas organisations, so they look to find and leverage any cost-effective tools available to make their operations more streamlined. This explains why offshore oil seep detection using satellite synthetic aperture radar (SAR) is an increasingly established method for assisting in the reduction of exploration risk for offshore frontier basins or for re-evaluating previously explored regions.

SAR-based slick-detection techniques rely on observing the variation in return signal and noting any anomalous areas caused by the dampening effect that oil on the sea surface has on wave heights. This presence of oil seepage slicks implies a working hydrocarbon system with leaking traps.

Airbus Defence and Space has been using satellite radar data for more than 20 years to identify the location of sea surface slicks associated with natural oil seeps emanating from the seafloor. As this 'Global Seeps Database' continues to develop, new frontier basins are being assessed and in parallel, as the archive of imagery over a particular location builds over time, increased confidence can be placed in the identification of slicks.

As an example, exploration efforts are gearing up around the Adriatic coast of Croatia. Airbus Defence and Space and seismic multi-client acquisition and imaging specialists Spectrum Geo collaborated to produce a joint study correlating natural oil seeps identified from radar and optical satellites with 2D seismic data to assist hydrocarbon exploration in this Adriatic Basin. Results suggested a strong correlation between higher confidence slicks and structural features interpreted from a Spectrum Geo's 2D seismic survey acquired offshore Croatia in 2013, allowing the targeting of further exploration work.

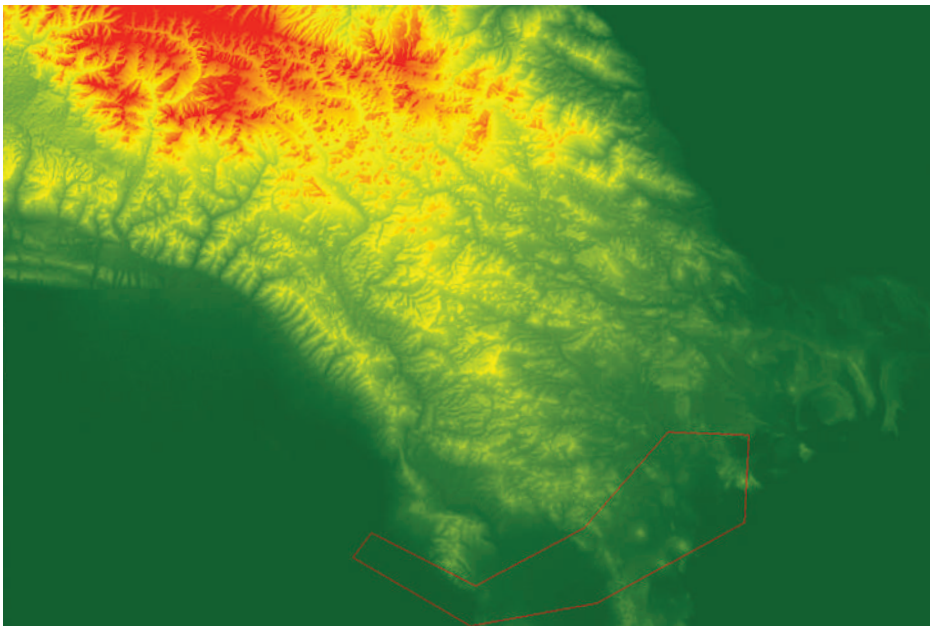

Figure 1. Elevation30 and pipeline corridor in red ©Airbus DS

Regular monitoring

Satellite imagery is also a very powerful tool for regular monitoring. A pilot test has recently been carried out over an offshore region in Angolan waters covering several thousand square kilometres, with daily acquisition performed over 11 days.

The aim was to use a combination of radar and optical data to image and identify all offshore activity including static oil rigs and drillships, as well as support vessels and tankers. Oil slicks were also documented and classified. Both the optical and radar constellation were leveraged, adapting the tasking strategy to the weather conditions: for example, radar satellites when weather conditions led to thick cloud cover or optical satellites for the highest resolution imagery when clear weather conditions allowed high visibility.

The combination of radar and optical surveillance tools proved particularly effective. Radar satellites, such as the TerraSAR-X operating in Wide ScanSAR mode (40m resolution for images size up to 270km per 200km), are effective for detecting leaks over large areas of open sea. This detection is based on the mirroring effect oil slicks have on the water surface, as waves are dampened by the oil presence, while optical sensors can identify the smallest items in high resolution.

Conclusion

Both archive and freshly acquired high-resolution satellite imagery are changing the way energy and engineering companies see the world. The ability to task satellites and then rapidly view up-to-date images taken anywhere in the world is a highly valuable capability. From assessing geological structures in remote locations to guiding exploration in the Adriatic Sea, satellite imagery and derived services are contributing to the decision-making capabilities of a wide array of organisations.

Figure 2. Pléiades imagery product at 50cm to refine the pipeline route ©Cnes 2015. Distribution Airbus DS

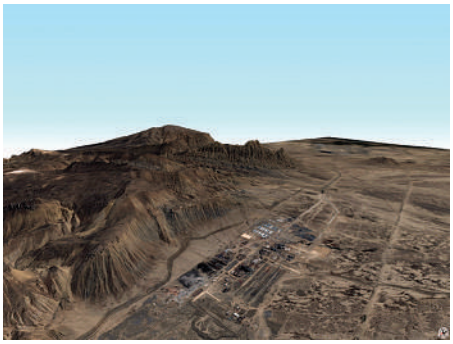

Figure 3. Elevation1 digital elevation model, overlaid with Pléiades image

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