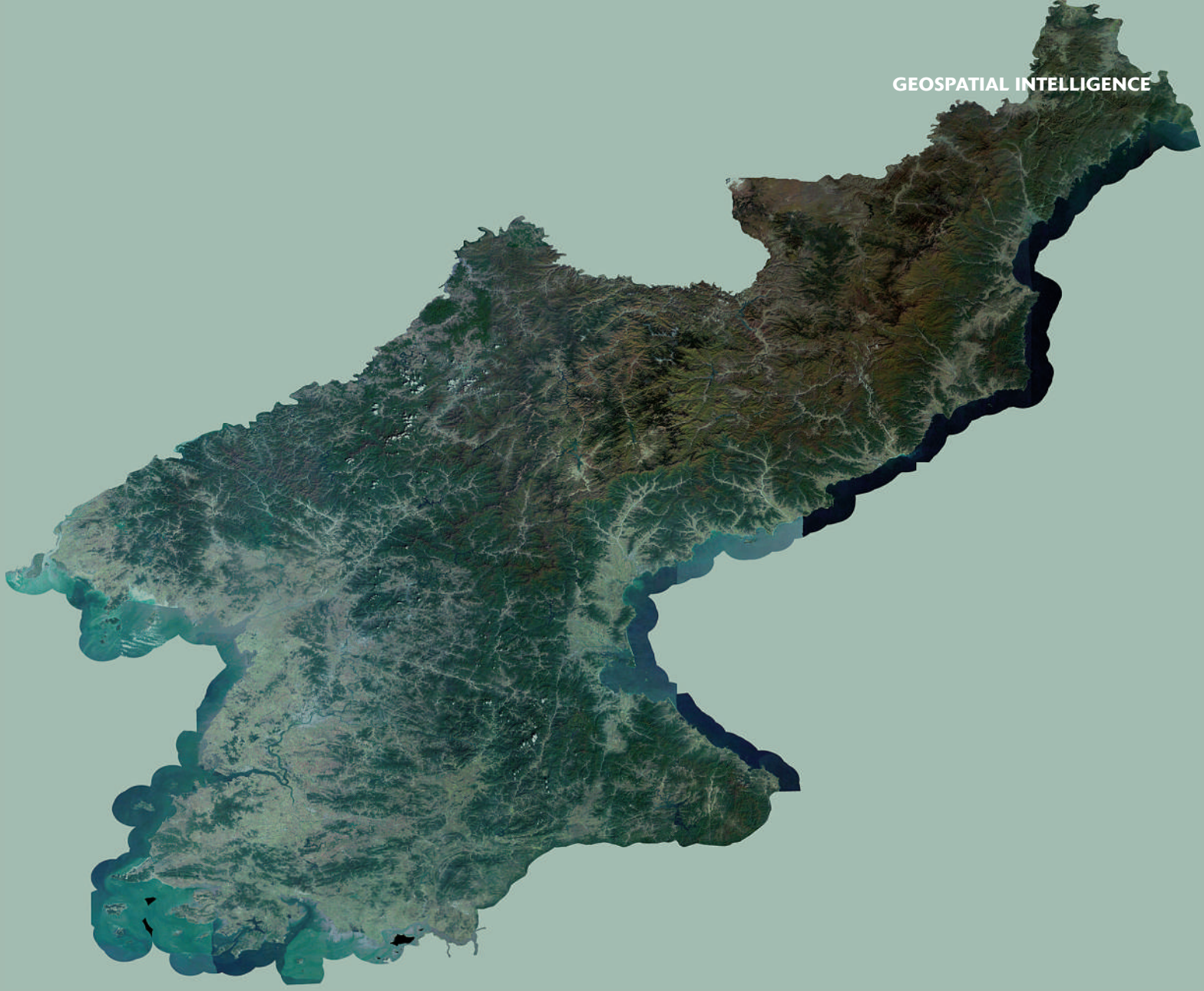

ASSESS THE INACCESSIBLE

A NEW TOOL COMBINES VERIFIED GEOSPATIAL LAYERS AND BLANKET ORTHORECTIFIED COLOUR IMAGERY MOSAICS OVER SPECIFIC AREAS AT RISK, TO HELP GEOSPATIAL INTELLIGENCE PROFESSIONALS KNOW WHAT'S TRULY HAPPENING ON THE GROUND – EVEN WHEN IT'S INACCESSIBLE. ERIC ANDREU LOOKS AT HOW IT'S ALREADY BEING USED TO MONITOR NORTH KOREA'S NUCLEAR PROGRAMME

Geospatial intelligence leaders typically operate in high tempo environments and use a variety of intelligence sources to reach their decisions. Among these are huge groups of open source data, which must be managed, combined and analysed in the most effective way to deliver clear and actionable results.

Airbus Defence and Space and IHS Jane's have partnered to deliver a geographical intelligence tool for these geospatial intelligence professionals, focused on countries of conflict and high risk. Named Conflict Atlas, it combines accurate and up-to-date SPOT 6, SPOT 7 and Pléiades satellite imagery with daily insight and analysis.

For decades, North Korea has been one of the world's most secretive societies and isolated from the rest of the world. In 2003, the country announced its withdrawal from the Treaty on the Non-Proliferation of Nuclear Weapons, and international inspectors are no longer allowed to visit nuclear sites. In their absence, one way to get objective information is precise satellite imagery analysis.

North Korea appears to have brought a second hall of uranium enrichment centrifuges into service at its Yongbyon site, which is capable of producing both plutonium and highly enriched uranium. IHS Jane's has examined the evidence of this potential operational activity using multi-temporal satellite imagery series and open-source data, including specific information on the first hall of the Yongbyon Uranium Enrichment Workshop gleaned from an authorised visit in 2010. Construction began on a new building adjacent to the first

Figure 1. Pléiades images acquisition on 22 October 2014 (left) and 02 October 2015 (right) on the north portal. New spoil pile is visible on the bottom part of the image and main spoil pile has also increased (©CNES 2014 and 2015, Distribution Airbus DS)

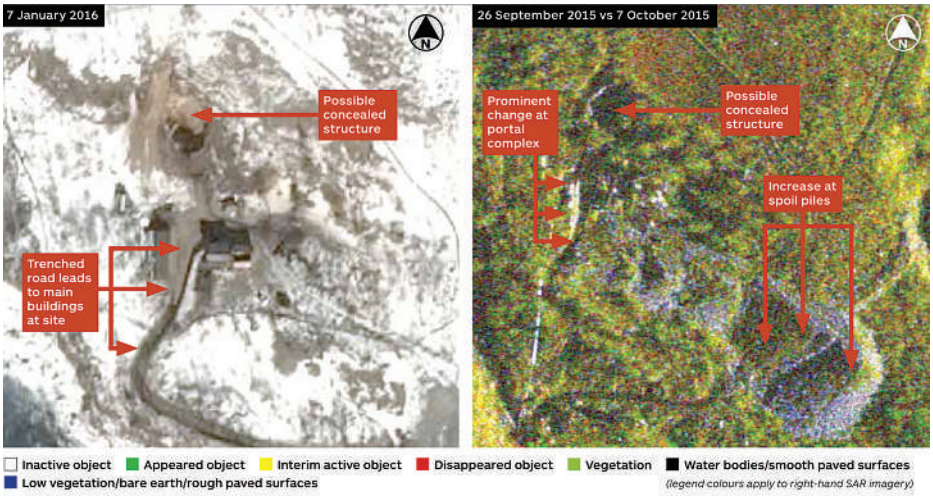

Figure 2. Punggye-ri, north portal: spoil piles change detection analysis (©DLR eV 2014-15 and ©Airbus DS Geo GmbH 2014-15/©2016 IHS)

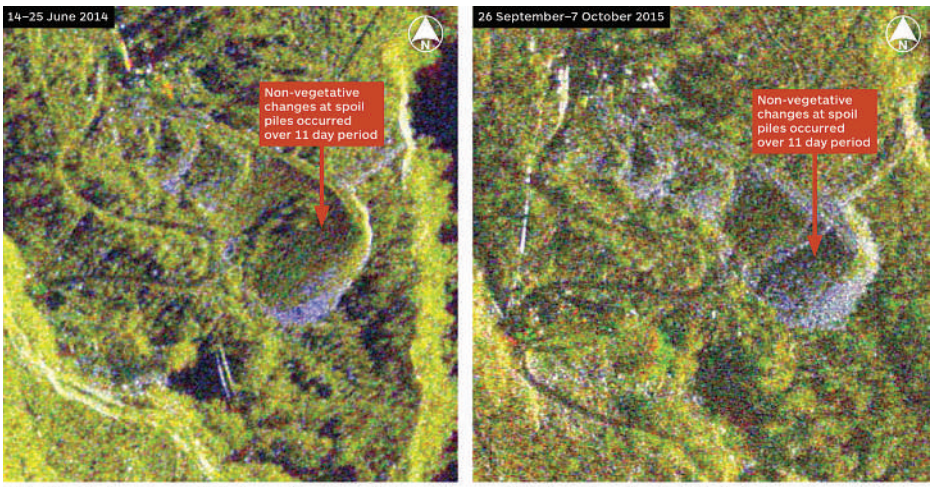

Figure 3. Punggye-ri, north portal: spoil piles change detection analysis using both optical and radar satellite imagery (©Cnes 2015, Distribution Airbus DS and ©DLR eV 2014-15 and ©Airbus DS Geo GmbH 2014-15/© 2016 IHS)

centrifuge hall in March 2013 and it appeared to be externally complete by early November 2013. This building has similar dimensions to the first centrifuge hall and is therefore likely to also contain centrifuges. It was also likely to require a similar period of time to bring into operation, if it also contained 2,000 centrifuges. This implied a start-up date of late 2014 or early 2015.

Without access to the interior of the buildings, observation of what goes into and comes out of the second building is required to understand its status. Heat radiated from a building is a good indicator of some of the possible activity inside, especially if there is no external source of heat for the building. Consequently, if heat is being radiated from the centrifuge buildings it would have to come from either electric heaters or more likely the compressors, motors, pumps, and electrical components related to the centrifuges. Running 2,000 centrifuges would generate a considerable amount of heat.

One way to detect a heat source inside a building is to observe the evidence of heated air on the building's roof and its surroundings. Snowmelt on the building's roof is a good indicator. A satellite image taken on 10 January 2013 shows three melted areas on the roof, with a dark area showing the most melt, a small area between the two-storey additions, and a lower area appearing to have 10 closely spaced vents pumping heated air onto the roof. Earlier images showed that there are small windows or vents near the top of the centrifuge hall's southern wall. These vents appear to allow warm air out of the building and melt the snow on the lower roof. This indicates that on 10 January 2013 the centrifuges inside the building were probably operating.

The winter of 2014/2015 was especially cold in North Korea from late December 2014 to early February 2015. In addition, only small amounts of new snow fell at Yongbyon during this period.

Analysis of the six available images, which were collected between 24 December 2015 and 6 February 2016, suggested that for the first time there was some snowmelt on the roof of a single-storey small building at the west end of the second hall, where there are four windows or vents. This indicates that some heat was being generated in the second hall, while the melted areas on attached buildings had become larger, indicating continuing activity.

The most significant change occurred in imagery from 6 February, when 50% of the roof of the first hall was clear of snow and there was additional snowmelt on the roof of the second hall. The significant change was melted snow on the roofs of adjacent two-storey buildings on the north side of the second hall.

Snowmelt occurred only on the roofs of two other buildings elsewhere in the fuel fabrication facility and none in the plutonium reprocessing area during this time. The buildings that produce hydrofluoric acid and a small building thought to produce uranium hexafluoride (UF_6) gas, a compound used in the uranium enrichment process as feed stock for the centrifuges showed a small amount of melting, strongly suggesting that the processes inside these buildings were causing the melting and not general building heating.

Using satellite imagery analysis and open-source information, IHS Jane's has concluded that a second hall containing centrifuges is now likely to be operational. That could, if both halls are functioning, double the amount of enriched UF_6 gas available to produce low-enriched uranium

for reactor fuel, which if enriched further produces highly-enriched uranium.

Underground activities

North Korea's nuclear weapons programme, based on the simultaneous development of a weaponisable nuclear device and ballistic missile delivery systems, appears to have advanced incrementally early this year. In a further effort to assess progress, IHS Jane's has worked with Airbus Defence and Space's TerraSAR-X Earth observation radar satellite analysts to analyse radar imagery of the two key facilities of Sohae (a satellite launch pad) and Punggye-ri (a nuclear device testing area).

TerraSAR-X has collected a series of Staring SpotLight imagery (25cm resolution), allowing a more granular view of details of the target area of interest. Layered together, minute details of the change that occurred between these images are immediately apparent.

Punggye-ri

Punggye-ri consists of a central operations base connected by road to four portals (north, south, east and west), three of which are active. In the past few years, earth has been continuously excavated from each of these portals and piled outside each in 'spoil piles'. Increases in these spoil piles confirm continued excavation and thereby continued intent on the part of North Korea to conduct tests at this nuclear test site (see Figure 1).

SAR change detection has confirmed nuanced activity at Punggye-ri in the months leading up to the 6 January test this year, as well as Pléiades satellite imagery. At the operations base, this analysis indicates new construction, roadwork, and grading have occurred just north and south of the facility, and analysis of optical imagery confirms that construction of two new buildings at the operations base was under way in October last year and complete by 7 January this year.

West portal SAR analysis showed soil piles increases and change of structures or vehicles present at the portal entrance between 26 September and 7 October last year, indicating concentrated activity and increased excavation in a short time frame.

At the north portal, SAR change detection confirms an increase in the volume of the tailings, denoting continued excavation of this site. Between 26 September and 7 October last year alone, significant changes to the spoil pile confirm a heightened pace of activity at this portal, confirmed by Pléiades imagery. Activity between buildings is prominent relative to the other sites (see Figure 2).

The SAR change detection analysis contradicts other media reporting of diminished activity in the weeks leading up to the test. It suggests that a faintly perceptible but steady stream of activity, as well as construction and excavation, was underway at Punggye-ri in the run-up to this year's nuclear test (see Figure 3).

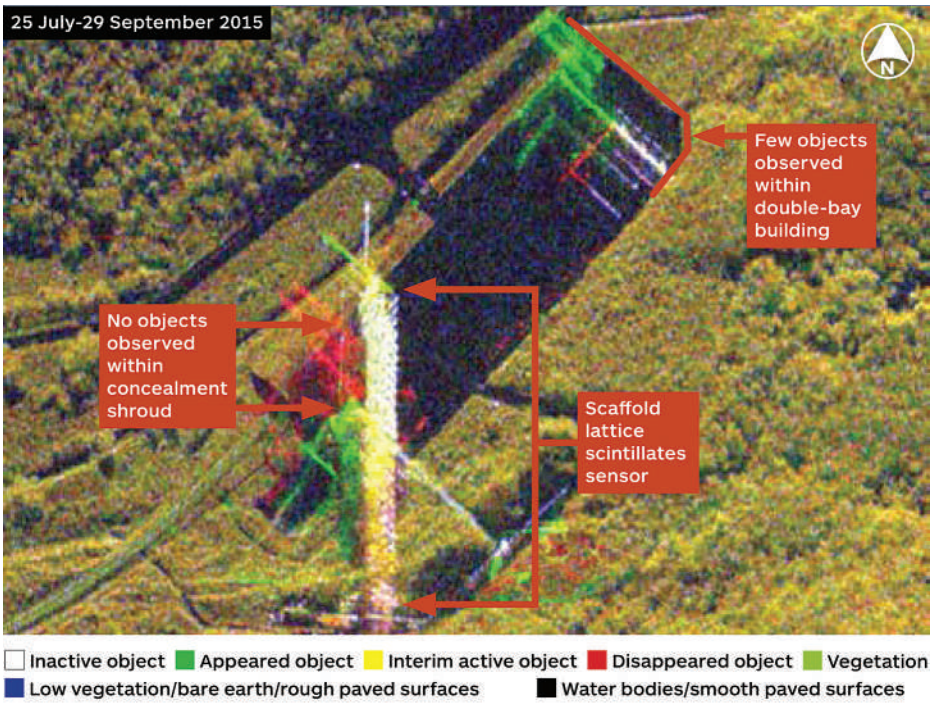

Figure 4. Launch pad, Sohae Satellite Launching Station, North Korea (©DLR eV 2015 and ©Airbus DS Geo GmbH 2015/©2016 IHS)

Sohae launch pad

Staring SpotLight 25cm TerraSAR-X imagery was also collected on multiple dates over Sohae, with the most recent image from 28 January. From this single image alone, new details emerge about the nature of activity and buildings in this complex. Additionally, this 28 January image was processed against another SAR image taken on 29 September last year to highlight just the changes that transpired in that time frame.

This change detection illustrates nuanced details in construction and objects as they appeared or disappeared from the timescape.

The rail terminal near the horizontal rocket assembly facility at Sohae was covered over with a concealment structure last year. There are two rail lines within this building, one that extends directly to the rocket launch pad. Because of this link, and its proximity to the horizontal rocket assembly and testing facility, the rail terminal is used to transport sensitive rocket components directly to the launch pad. The terminal's roof is made of a material transparent to radar, and TerraSAR-X imagery penetrated through this material to detect an object (returns indicate several metres in length and metallic) within the building on 29 January (see Figure 4).

A double-bay building on the eastern end of the launch pad was recently built to conceal and protect the rocket stages on the launch pad before moving them along a track towards the launch tower on the opposite side of the pad. TerraSAR-X sensor could penetrate this double-bay building's exterior, providing a glimpse inside the building where only a few visible objects were present on the image dates. Before the 7 February launch, this large building was not used for storage, but rather staging and concealment of rocket components just before launch.

Conclusion

To support better situational understanding, Conflict Atlas contains Airbus Defence and Space's blanket orthorectified colour imagery mosaics over specific areas at risk, locally enriched with high resolution images over the densest, most critical areas, such as city centres, airports and military installations. This geographical layer has been combined with IHS Jane's trusted and verified geospatial layers, delivering military and missile sites, terrorism events and daily country specific insight. This unique and powerful tool will help intelligence professional share and verify important content, reduce the challenges across big data and quickly identify areas that require immediate focus

INCREASES IN THESE SPOIL PILES CONFIRM NORTH KOREA'S INTENT TO CONDUCT NUCLEAR TESTS AT THIS SITE

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