Brontopixels

Some years back I wrote in this column, “Today, Earth observation (EO) satellites are being constructed and launched at conveyor-belt speed.” This avowal was confirmed at the 14th Int’l Scientific and Technical Conference, ‘From Imagery to Map’, held recently in Hainan, China. To date over 200 optical EO satellites are in orbit, run by governmental agencies or private firms in over 30 countries, including former USSR country Kazakhstan. The republic has a GDP of less than USD250 billion and is home to 17 million inhabitants. It is working hard to create a national space industry and, with the support of France’s Airbus Defence and Space, has constructed a very-high-resolution (VHR) EO satellite which launched on 30 April 2014. The ground sample distance (GSD) of the panchromatic (pan) mode is 1m, and 4m for the four multispectral (MS) bands. The amount of pixels captured annually by all the orbiting sensors should no longer be counted in petapixels (10^{15}) or zettapixels (10^{21}) but rather in yottapixels (10^{24}), and this will soon become brontopixels (10^{27}). The data can easily be stored on mass solid state devices but all the computer power in the world is not enough to transfer the massive amount of pixels into information fit for use in a reasonable amount of time and at acceptable costs. One may even question whether it is wise to produce such high volumes if only a small portion will be used…perhaps enough is enough. The construction, launch and operation of an EO satellite takes a big chunk out of the sovereign budget and some people might argue that this is a waste of taxpayers’ money – money that could be better spent on the repair of roads and dikes or on public health and social security. Others may counter that the effort is justifiable, as a space programme brings prestige to politicians and nations alike. Moreover, despite the optimism of many leaders when the Cold War ended 25 years ago, quarrels between nations continue and armed attacks remain a very real possibility. In today’s world, competing camps play power games – the tension is tangible and the fear of raids has become a part of everyday life for millions. Russia and Asia are not only attempting to usurp the USA as the issuer of the world’s reserve currency but are also challenging its space hegemony as they launch one EO satellite after the other. The power balance is gradually shifting, and many nations – large and small – are keen to ensure that no foreign blocks or bans will disrupt life within their territory. Many no longer want to rely on other nations’ promises and prefer instead to follow their own path to the future. They know how quickly faith can evaporate and world leaders’ power can crumble when they run out of taxpayers’ money. When it comes to space technology, any emerging economy has the right to try to take a piece of the Earth’s exosphere. In the meantime the USA continues to extend its fleet of spacecraft with on-board optical sensors at conveyor-belt speed. On 13 August 2014, DigitalGlobe launched WorldView-3 into an orbit 617km above the ground. The GSD of the pan mode is 31cm and 1.24m for MS imagery. The average revisit time is around one day, and up to 680,000km^2 can be captured daily. Due to US regulations the GSD has to be resampled to 40cm prior to delivery. To date, 11 spacecraft collect optical imagery at a GSD better than 1m: WorldView 1 (46cm), 2 (46cm) and 3 (31cm); GeoEye 1 (46cm) and 2 (34cm); the Pleiades twins (50cm), Quickbird (65cm); Ikonos (82cm); and the SkySat twins (90cm).