ISSN 2624-9081 • DOI 10.26034/roadsides-202200704

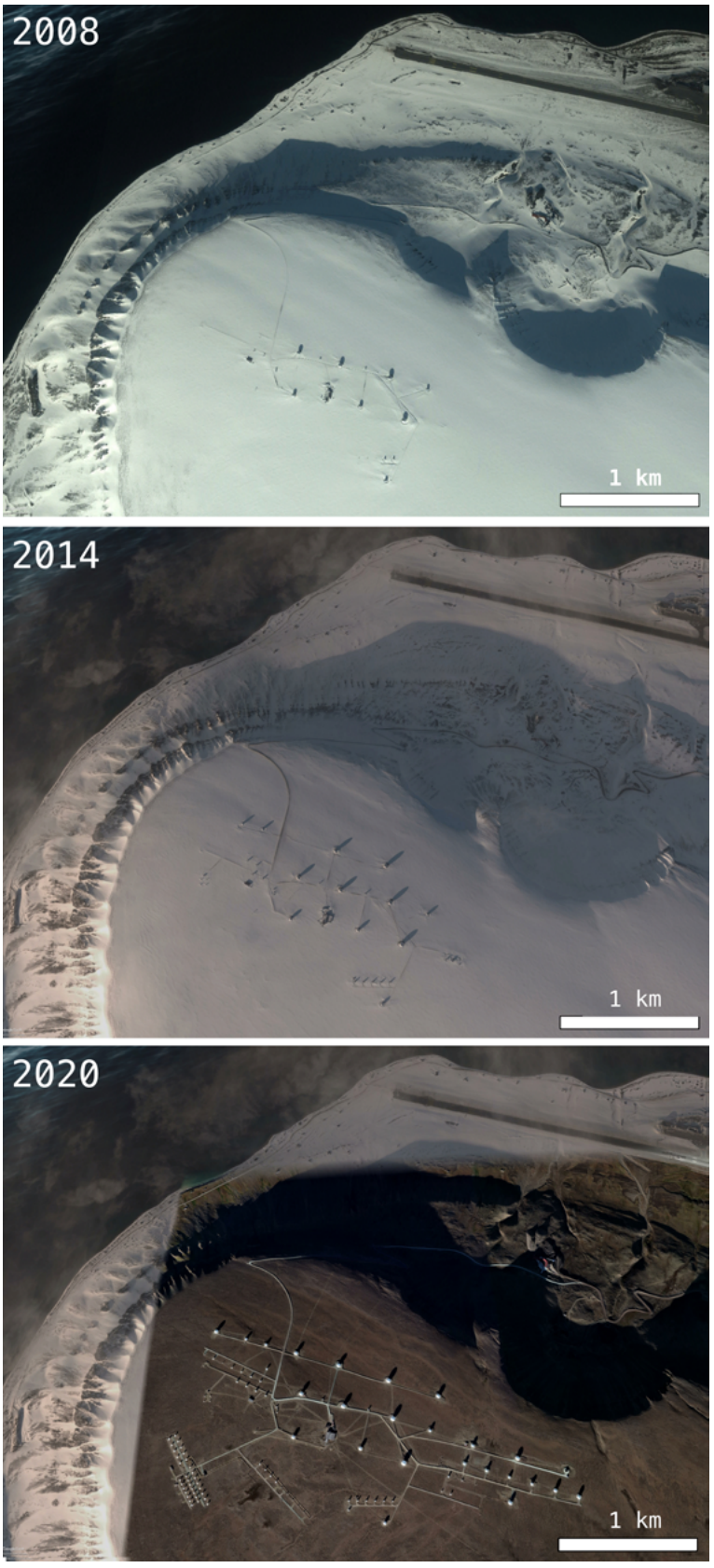
Satellite Underworld

Mia M. Bennett

We surf the web and trawl Google Earth, oblivious to the toll of the endless scroll. But how do photos taken of the planet from above reach us down below – and what are the hidden politics and logistics of the transmission of data from space to the ground?

Since the dawn of the satellite era in 1957, over 11,000 satellites have rocketed into space. With every passing year, an exponentially increasing number of satellites are sent into orbit to support Earth observation and communications. These spaceborne instruments are now critical to logistics at a range of scales, doing everything from assisting combines with precision farming to guiding ships through Arctic ice.

In reckoning with how satellites have transformed understandings of the planet, critiques have largely focused on the globe-spanning view from above (Cosgrove 2001; DeLoughrey 2014). Yet the 'planetary gaze' forms a somewhat myopic lens, training attention on satellite aesthetics while obscuring the nitty-gritty logistics underlying the data and the localized ramifications of its production and circulation. Satellites are depicted as operating autonomously in the vacuum of space. But they form part of a wider circuitry that touches down on Earth in an often-brutal manner, in environments



Svalbard Satellite Station's growth over time.
Original imagery: Maxar/ Google Earth Pro.

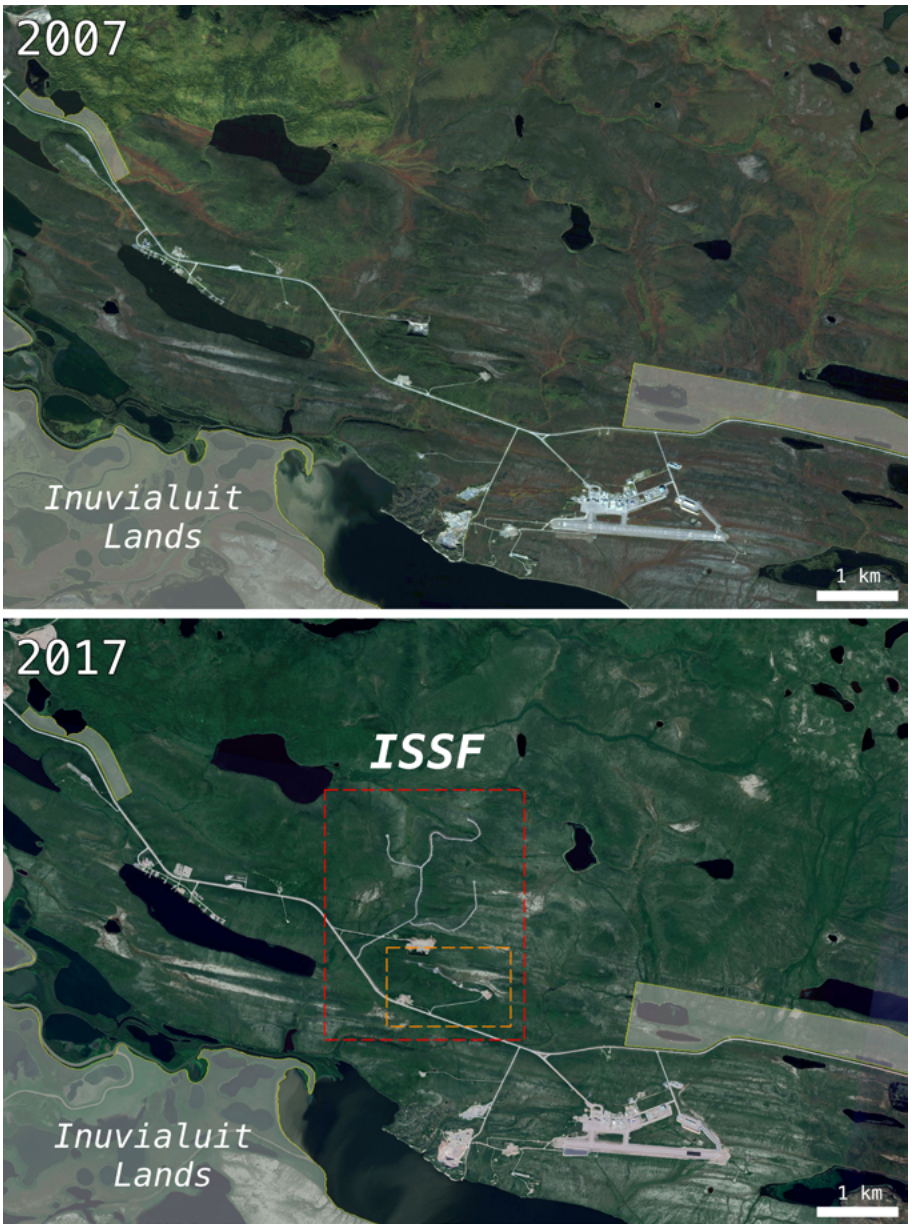
or among populations deemed by sovereign states to be peripheral and displaceable – and therefore ideal for making room for the space industry (Swanner 2017).

Crucial to the web of logistics underpinning satellites are ground stations, which downlink data collected in space and transmit it to terrestrial computer systems for analysis. These lowly facilities are built in locations with a direct line of sight to satellites as they pass overhead. During each overpass, a satellite transmits its data via radio or microwaves to a receiving antenna – typically a 7m- or 12m-wide parabolic dish sometimes covered in a weatherproof enclosure, or radome, to protect it from the elements – at the ground station below. If a satellite does not frequently fly over the same place, more ground stations must be built at multiple locations within its line of sight to ensure the timely transmission of data.

The satellite industry's land-use demands are unevenly distributed across the planet. A ground station's location depends on a satellite's particular orbit, which is selected based on the operator's purpose. For instance, Earth-observing satellites whose imagery is used for science or surveillance often have polar orbits, gliding along a different line of longitude every time they circle the North and South Pole, enabling global coverage. For such satellites, polar ground stations are desirable because the high number of overpasses permits regular and efficient data transmission. When built in remote places, ground stations also offer states a means of concretizing their presence, particularly in areas where sovereignty claims are frozen, as in Antarctica, or increasingly called into question, as in the Norwegian territory of Svalbard. In both of these icy locales, Norwegian company Kongsberg Satellite Services, whose parent company is Kongsberg Gruppen – a major arms manufacturer and the world's leading producer of remote weapons systems – manages ground stations. Operations like these exemplify the inseparability of satellite logistics from warfare.

As the number of polar-orbiting satellites grows, interest in building ground stations in the Arctic and Antarctic is rising. In the rush to deliver Earth observations to end-users, alien arrays of lily-white dishes are popping up above the snow, while fiber optic cables are being woven around the world. The impact assessment for a forthcoming satellite communications antenna at McMurdo Station, an American research base in Antarctica, warns that it will cause numerous "earth-disturbing activities" (National Science Foundation Office of Polar Programs 2017: 5). Although the antenna is merely the size of a house, its construction will require "excavating approximately 42,300 m^3 of rock and soil" and "drilling up to … a total of approximately 1,300 holes" in order to detonate 16,800 kg of explosives "in no more than 70 discrete blast events." Blast off, indeed.

The social and environmental impacts of polar satellite ground stations are more severe when they infringe upon Indigenous homelands. Sweden's Esrange Space Center and Canada's Inuvik Satellite Station Facility (ISSF) are surrounded by Sámi, Inuvialuit and Gwich'in lands, respectively. Since 2010, the facilities have together offered the Kinuvik Concept. As the Swedish Space Corporation operates antennas at both sites, it sells bundled services for the two facilities, "offering contact opportunity on every orbit" to low-Earth orbiting polar satellites (Swedish Space Corporation 2021). Yet strengthening contact between satellites and antennas can mean splitting local populations from



The Inuvik Satellite Station Facility's expansion is pushing new roads into the tundra. Orange line: original site. Red line: expanded site. White overlay: Inuvialuit lands.
Original imagery: Maxar/ Google Earth Pro. Inuvialuit lands data: Government of Canada

their traditional resource bases. Aside from the disturbances caused by construction, once an antenna array is in place, it may impede activities such as reindeer herding, hunting, gathering and fishing.

Few obstructions stand in the way of satellite data, with states using public funds to lubricate its seamless circulation. In 2017, the 1,154-km Mackenzie Valley Fibre Link opened to support the ISSF's continued expansion. The six-inch-wide cable hews to the route proposed in the 1970s for a controversial natural gas pipeline that was never realized, laying bare the path dependencies of digital infrastructures, despite their levitative qualities, on grimier industries. In the words of its operator, a private–public partnership, the Fibre Link has "solved the challenge of transmitting large data quantities

across Canada's north and beyond – quickly, reliably, and affordably" (Mackenzie Valley Fibre Link 2016). No mention is made of the trench dug into the boreal forest across the Northwest Territories to install it, nor the "unacceptable" protection levels for wildfire and fisheries, improper waste disposal, exposed holes and erosion which inspections have revealed (Thurston 2016). To make matters worse, the "last miles" of cable needed to provide nearby communities with high-speed internet are frequently yet to be laid (Desmarais 2020). What good is space infrastructure to residents if they cannot even view the data received by the antennas crowding their horizons?

Kashgar Ground Station in relation to damaged cultural sites in Xinjiang. Original imagery: Maxar/ Google Earth Pro. Damaged cultural sites data: Ruser et al. 2020.

Far from the Arctic, yet in a place which, too, is remote and territorially strategic, sits a ground station in Xinjiang Uyghur Autonomous Region. Located outside Kashgar, China's westernmost city, Kashgar Ground Station (Ch. 喀什地面站) is one of four facilities built across the extremities of the country's territory to ensure national satellite coverage. The station nestles between a highway, patches of rusty soil and irrigated arrays of verdant trees. With its arched windows and tan walls, the facility's main building, opened in 2008, reflects the local Islamic architecture. This façade is ironic, if not altogether shameless, considering that satellite imagery analysis has uncovered the destruction or damage of thousands of mosques and cultural sites in Xinjiang since 2017, including two just kilometers from the ground station (Ruser et al. 2020). Outside the building, a half-dozen ground antennas stand on the cinnamon soil listening to the skies, downlinking data from foreign satellites and the rapidly increasing number of Chinese ones as well (Luk and Wijeyeratne 2020).

The Chinese government intends to leverage satellite data in a slippery slope of applications ranging from emergency response to maritime surveillance. With Xinjiang serving as one of China's two key regional demonstration areas for its high-resolution Earth observation system (Cankao Xiaoxi 2017), Kashgar Ground Station acts as a critical node for connecting spaceborne imagery to potentially oppressive applications on the ground. Chinese media portrays the station as instrumental to taming the restive region. One article asserted, "For the past ten years, the workers at the [Kashgar] Ground Station have struck roots into our motherland's western frontier. Living on the frontlines of the fight against terrorism, they have made outstanding contributions to the development of our country's science and technology and to the long-term stability of the frontier" (Gao 2018).[1] The ground station's alleged centrality to both China's space program and its territorialization strategies exposes how the earthly emplacements of satellite logistics can undergird the violent control of territory. In turn, the petabytes of data these facilities accumulate can be harnessed to police and persecute populations.

Ground stations have largely formed part of the "unexamined background," to borrow from Neilson (2012: 324), of the satellite industry. Data captured by orbiting instruments is transmitted to a fixed terrestrial location, often a peripheral corner of Earth, before coursing through submarine or subterranean cables to reach an analyst, who is typically sitting at a computer thousands of kilometers away in a more urbanized, temperate locale. The analyst may be oblivious to where the pixels they are manipulating first touched down onto the planet's soil. Yet those who live where data is downlinked are all too aware of how space and satellite logistics enclose, extort and upend their homes (cf. Goodyear-Ka'ōpua 2017; LaDuke and Cowen 2020). As nations cheer the liftoff of rockets and remote sensors, it is frequently the people residing within former frontiers who must shoulder the burden of bringing the data back down to Earth – or worse, become the target of its applications. To critique the rise of satellites, it is imperative to train our eyes not only on the skies, but on the ground, too.

Notes:

[1] The author is grateful to Trym Eiterjord for his translation from the original source in Putonghua.

References:

Cankao Xiaoxi, 2017. "新疆高分卫星广泛应用于生态环境和安全应急领域," 20 April. http://www.cankaoxiaoxi.com/china/20170420/1912372.shtml?sg_news

Cosgrove, Denis. 2003. *Apollo's Eye: A Cartographic Genealogy of the Earth in the Western Imagination*. Baltimore, MD: Johns Hopkins University Press.

DeLoughrey, Elizabeth. 2014. "Satellite planetarity and the ends of the Earth." *Public Culture* 26 (2): 257–80.

Desmarais, Anna. 2020. "N.W.T.'s Mackenzie Valley fibre line not living up to expectations, experts say." *CBC News*, 25 June. https://www.cbc.ca/news/canada/north/mackenzie-valley-fibre-line-last-mile-1.5625828

Gao, Yali. 2018. "中国遥感卫星地面站喀什站：坚守边陲十年"牧星人." *中国科学报* 5, 22 January. https://news.sciencenet.cn/htmlnews/2018/1/400710.shtm

Goodyear-Kaʻōpua, Noelani. 2017. "Protectors of the future, not protestors of the past: Indigenous Pacific activism and Mauna a Wākea." *South Atlantic Quarterly* 116 (1): 184–94.

LaDuke, Winona and Deborah Cowen. 2020. "Beyond Wiindigo infrastructure." *South Atlantic Quarterly* 119 (2): 243–68.

Luk, Christine Y. L. and Subodhana Wijeyeratne. 2020. "Alternatives to GPS: Space Infrastructure in China and Japan." *Roadsides* 3: 57-62. https://doi.org/10.26034/roadsides-202000308

Mackenzie Valley Fiber Link. 2022. "Northern Opportunities, World Class Possibilities: The Mackenzie Valley Fibre Link." https://www.mvfl.ca/

National Science Foundation Office of Polar Programs. 2017. "Environmental Document Concurrence: Construction, Operation, and Maintenance of a Satellite Communications Antenna (Ross Island Earth Station) at McMurdo Station, Antarctica." https://www.ats.aq/documents/EIA/01939enMCST1801.IEE.pdf

Neilson, Brett. 2012. "Five theses on understanding logistics as power." *Distinktion: Scandinavian Journal of Social Theory* 13 (3): 322–39.

Ruser, Nathan, James Leibold, Kelsey Munro and Tilla Hoja. 2020. *Cultural Erasure*. Canberra: Australian Strategic Policy Institute. https://www.aspi.org.au/report/cultural-erasure

Swanner, Leandra. 2017. "Instruments of science or conquest? Neocolonialism and modern American astronomy." *Historical Studies in the Natural Sciences* 47 (3): 293–319.

Swedish Space Corporation. 2021. "The Kinuvik Concept." https://sscspace.com/ssc-worldwide/ground-station-network/the-kinuvik-concept/

Thurston, David. 2016. "Inspection reports cite environmental concerns with Mackenzie Valley fibre optic project." *CBC News*, 1 February. https://www.cbc.ca/news/canada/north/mackenzie-valley-fibre-inspection-1.3428012

Cite as: Bennett, Mia M. 2022. “Satellite Underworld.” *Roadsides* 7: 21-28. https://doi.org/10.26034/roadsides-202200704

Author:

Mia Bennett is an Assistant Professor in the Department of Geography at the University of Washington. Through fieldwork and remote sensing, she researches the politics of infrastructure development in frontier spaces, namely the Arctic and areas included within China’s Belt and Road Initiative. She also runs a blog, Cryopolitics, which provides Arctic news, analysis and photography. Bennett received a PhD from UCLA and an MPhil from the University of Cambridge. Previously, she worked at the University of Hong Kong.

Roadsides is a diamond Open Access journal designated to be a forum devoted to exploring the social, cultural and political life of infrastructure.

roadsides.net
editor@roadsides.net
@road_sides
@roadsides_journal

Editorial Team:
Julie Chu (University of Chicago)
Tina Harris (University of Amsterdam)
Agnieszka Joniak-Lüthi (University of Fribourg)
Madlen Kobi (Academy of Architecture, Mendrisio)
Galen Murton (James Madison University, Harrisonburg)
Nadine Plachta (University of Toronto)
Matthäus Rest (Max-Planck-Institute for the Science of Human History, Jena)
Alessandro Rippa (LMU Munich and Tallinn University)
Martin Saxer (LMU Munich)
Christina Schwenkel (University of California, Riverside)
Max D. Woodworth (The Ohio State University)

Collection no. 007 was edited by: Julie Y. Chu and Tina Harris
Managing editors: Agnieszka Joniak-Lüthi and Tina Harris
Copyediting: David Hawkins
Layout: Chantal Hinni and Antoni Kwiatkowski

ISSN 2624-9081

Creative Commons License
This work is licensed under a Creative Commons Attribution-NonCommercial-ShareAlike 4.0 International License.

Cover design: Creative Direction Julie Y. Chu, Illustration Shahira Bhasha