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Viewpoint

Balancing Privacy Rights and the Production of High-Quality Satellite Imagery

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The use of satellite imagery, first inspired by the need for weather monitoring and defense intelligence, has led to some of society's most influential discoveries. Technological advances continue to provide data with increasing detail, or spatial resolution. Between 1980 and 2016, average spatial resolution improved nearly 20-fold, from pixel sizes of roughly 500 to 25 m[1] (Figure 1). Higher spatial resolution has offered improvements in fields such as image classification and water quality monitoring.[2] The 2019 launch of the Indian Space Research Organization Cartosat-3 satellite put into orbit the finest-resolution commercial imagery to date. Cartosat-3 collects panchromatic, essentially black and white, imagery at 0.28 m and multispectral imagery at 1.14 m, or about eight times the screen size of a modern smartphone. Advances in spatial resolution have been coupled with advances in image processing, as the analysis of large amounts of data becomes more feasible through improved data infrastructure and automated analysis techniques. Although high-resolution data provide exciting new research possibilities, serious privacy concerns have also been raised. The dilemma moving forward is to balance both technological advancements to support scientific research and individuals' legal and ethical rights to privacy.

Access to personal information, which can be captured inadvertently or deliberately in satellite imagery, will certainly evolve alongside technological advancements. Santos and Rapp[5] summarized identifiable information that can be directly and indirectly discerned using satellite imagery. While technology is not yet advanced enough to capture faces, identification by aggregating multiple discernible features in an image is possible. For example, contextualizing satellite imagery in reference to geographic locations, such as neighborhoods or even houses, can transform an individual in an image from arbitrary to distinguishable. Additional indirect privacy violations are of potential concern, including general unease and mistrust provoked by the notion of constant satellite surveillance. These concerns will only become heightened as technology improves.

Technological advancements have already encroached on some individuals' perception of privacy. In 2008, after users expressed concerns over seemingly all-seeing digital cameras, Google Street View began blurring identifying information such as faces, license plates, and addresses. However, before this technology was implemented, Google faced a lawsuit from a couple who claimed Google disregarded their privacy interests by capturing a photo of their home. The court dismissed the case. In 1984, a Florida sheriff received a tip that a homeowner was growing illegal substances on their property. After failing to gain intelligence from the ground, the officer took to the air, flying a helicopter overhead. After being charged with possession of marijuana, the homeowner challenged the state of Florida claiming the officer violated reasonable expectations of privacy, but the case was ruled in favor of the state. Events like these suggest that privacy concerns regarding high-resolution satellite imagery would be treated similarly, with the interests of satellite data providers being prioritized over an individual's perception of privacy rights.

Typically, privacy rights are addressed at the national level, but nations have inconsistent policies in place to address issues

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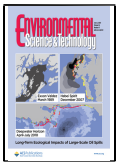

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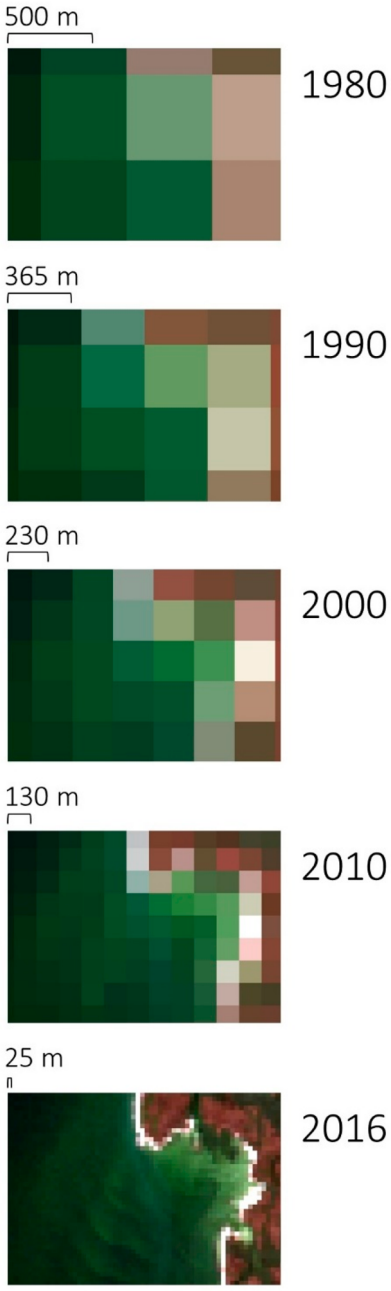

Figure 1. Advancements in remote sensing spatial resolution over the last four decades, and for 2016. Pixel size for each decade represents a 3-year moving average of Earth observing satellites' in operation for the given year.[1] Figure generated from Planet Lab's true color images[6] (copyright Planet Laboratories Inc. 2019 all rights reserved).

raised by satellite data. In the United States, production of satellite imagery finer than 0.31 m in resolution is restricted. European governments have enforced similar regulations, but no requirements exist for Indian or Chinese satellite imagery companies, which are quickly advancing in imaging capabilities. While national regulations are an important measure, satellites require an international solution. Early attempts to govern international space activities included the Outer Space Treaty of 1967. The treaty now includes over 100 countries and laid the foundation for the United Nations Remote Sensing Principles, which were formally adopted in 1986.[3] In part, these Principles encourage remote sensing activities for the benefit, and in the interests, of all countries, while promoting international laws. Yet, they still do not address privacy. Instead, many parallels can be drawn between privacy issues covered under the General Data Protection Regulation (GDPR) and those stemming from increased-resolution satellite imagery. GDPR was enacted in 2018 to protect residents of the European Union.[4] GDPR expands the definition of, and an individual's rights over, personal data, including social media posts, medical records, and location information. The directive requires individuals to explicitly grant permission for a company to obtain this data. While this policy makes great strides in protecting individuals' privacy, it is still only regional in nature and fails to address issues specific to satellites.

Conversations dedicated to closing this gap must occur on the international level. Policymakers should develop a strategy to balance privacy concerns and the desire for high-resolution imagery, perhaps consisting of three primary components: (1) Acknowledge information discernible through satellite imagery. As pixel size decreases, what new features can be extracted? (2) Promote transparency in how data are used, encouraging high-resolution imagery as a public service. Following the Remote Sensing Principles, it should encourage economic, social, scientific, and environmental advancements for all countries. How satellite imagery will advance each sector will need to be defined. (3) While open science is important, a clearance process needs to be set in place before high-resolution imagery is released to individual users, who should clearly state their intentions and findings.

The creation of an international committee could establish an impartial body overseeing the collection and distribution of satellite imagery. The committee would be tasked with first developing a strategy to address the components listed above. Once a strategy is in place, the committee would be tasked with supervising all aspects of the satellite data process, including communicating during the sensor design process, stating a mission's intended purpose and alternative information that could be derived from the data, and managing access to high-resolution imagery and derived information. The development of the Remote Sensing Principles and GDPR suggests there is a precedent for establishing a global solution, given previous pursuits to address related issues. Additionally, foundations presented in GDPR can be used to modernize protections proposed in the Remote Sensing Principles. While certainly time-consuming and subject to cooperation among many nations with varying capabilities and intentions, the establishment of a comprehensive resolution could foster substantial advancements in scientific capability while ensuring protection of individuals' legal rights and maintaining societal support for satellite missions.

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