FLYING UNDER THE RADAR: LOW-ALTITUDE LOCAL DRONE USE AND THE REENTRY OF PROPERTY RIGHTS

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ABSTRACT

The characteristics and capabilities of civilian drones have proliferated in recent years, giving rise to a burgeoning industry. The popular media and academic literature have predominantly focused on privacy concerns, devoting considerably less attention to the regulatory challenges created by the new technology. Congress instructed the FAA to integrate drones into the National Airspace System in 2012, but rulemaking delays and a moratorium on commercial uses hampered the industry and withheld benefits from the public.

Final regulations are now in place, but the new rules revive legal uncertainty over the constitutional limits of federal authority and the ambiguous vertical bounds of private property rights. Low-altitude local drone use is one of the most promising aspects of the technology, and lies at the outer edge of federal authority. Much of the current debate gets key questions exactly backwards. Under current Supreme Court precedent, the proper legal question is not whether federal airspace authority can extend lower to govern virtually all drone use, but whether drone use pushes private property rights in airspace higher, limiting federal authority. Therefore, this Issue Brief joins the scholarly criticism of FAA efforts to date and calls for a greater focus on clear property rights.

INTRODUCTION

The alternative rock band OK Go is famous for its creative, visually appealing, one-take music videos, like "Here it Goes Again," in which the band dances and glides on a series of treadmills.[1] In October of 2014, the band released another music video featuring unique camera

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[1] OK Go, *Here It Goes Again*, YOUTUBE (Feb. 26, 2009), https://www.youtube.com/watch?v=dTAAsCNK7RA.

work.[2] The camera moves in and around a number of dancers, alternating between close-ups and overhead shots several dozen feet off the ground. At the climax of the video, the camera soars into the clouds for an overhead shot nearly half a mile high, while several hundred dancers, now only small dots, compose intricate patterns and words on the surface.[3] It is all one continuous take and there is no room for a helicopter or crane. An observer might assume the video required considerable computer generated imagery. It was actually made using a drone in Japan.[4] Unfortunately, if the band wished to shoot that video in the United States, it would have been extremely difficult, if not impossible, to do so. Regulatory choices and delays impeded this kind of creativity and innovation in the United States. New regulations from the Federal Aviation Administration (FAA), effective August 29, 2016, aim to change the current dynamic by allowing the public to use drones for commercial purposes, as long as specific safety requirements are met.

"Drone" is a colloquial term referring to powered flying machines that do not carry a human operator. Other names include Unmanned Aerial Vehicles (UAV) and Unmanned Aircraft Systems (UAS). The technology first entered the public consciousness as a result of military operations during the Clinton administration, and rose to prominence in the post-9/11 conflicts during the Bush administration.[5] In recent years, high profile announcements have captured the public's imagination about a civilian drone industry, supplanting the exclusively military connotation for the term "drone." In 2012, a Silicon Valley startup, Tacocopter, drew national media attention with plans to use small drones for food delivery.[6] In 2013, Amazon announced the development of its Prime Air program, which aims

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[2] OK Go, *I Won't Let You Down*, YOUTUBE (Oct. 27, 2014), https://www.youtube.com/watch?v=u1ZB_rGFyeU.

[3] Harley Brown, *OK Go Deconstruct Their Drone-Filmed 'I Won't Let You Down' Video*, BILLBOARD (Oct. 27, 2014), http://www.billboard.com/articles/news/6296760/ok-go-i-wont-let-you-down-video-honda.

[4] *Id.*

[5] Nicholas Ryan Turza, *Dr. Dronelove: How We Should All Learn to Stop Worrying and Love Commercial Drones*, 15 N.C.J.L. & TECH. ON. 319, 323 (2014).

[6] Jason Gilbert, *Tacocopter Aims To Deliver Tacos Using Unmanned Drone Helicopters*, HUFFINGTON POST (Mar. 23, 2012), http://www.huffingtonpost.com/2012/03/23/tacocopter-startup-delivers-tacos-by-unmanned-drone-helicopter_n_1375842.html.

to offer package deliveries within minutes of purchase using a fleet of drones.[7]

Any discussion of drone technology and regulation necessarily involves a set of careful distinctions. The diverse range of capabilities and characteristics makes it impractical to meaningfully analyze the entire group of devices at once. For example, the largest military drones, like the Northrop Grumman Global Hawk, are as large as a small airliner, weigh over 32,000 pounds, and have wingspans over 130 feet.[8] At the other end of the spectrum is the AERIUS, from Aerix Drones, which measures a mere three centimeters wide, or roughly the size of a quarter.[9] The most important differences are between military and nonmilitary technology, government and civilian entities, and commercial and private uses.

This Issue Brief focuses on small UAS, operated by civilians, in a localized area, at relatively low altitudes, for recreational or commercial purposes. Part I gives an overview of the technological capabilities of these drones, as well as some current and potential uses. Part II describes the aviation regulatory framework that predates drones and the recent modifications to govern them. Part III takes a critical look at the limits of the FAA's power to regulate drones. Finally, Part IV calls for the demarcation of clear property rights in low-altitude airspace in order to clarify regulatory authority and minimize conflicts between operators and landowners.

I. THE TECHNOLOGY AND ITS USES

Drones can be of fixed wing design, generating lift from the flow of air over wings, just like a miniature airplane, or they can generate lift by directing air downward using rotors, just like a helicopter.[10] The latter design is now common, usually containing four, six, or even eight small rotors. It would be extremely difficult for an operator to control the craft by adjusting power to the various motors individually, so control software is needed. Electronic flight systems convert commands from the operator into power changes in one or more motors. As a result, drones can ascend

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[7] David Streitfeld, *Amazon Delivers Some Pie in the Sky*, N.Y. TIMES (Dec. 2, 2013), http://www.nytimes.com/2013/12/03/technology/amazon-delivers-some-pie-in-the-sky.html.

[8] NORTHROP GRUMMAN, RQ-4 GLOBAL HAWK5 (2008), www.northropgrumman.com/capabilities/rq4block20globalhawk/documents/hale_factsheet.pdf.

[9] *AERIUS - The NEW World's Smallest Quadcopter*, AERIX DRONES, https://aerixdrones.com/products/aerius-the-new-worlds-smallest-quadcopter (last visited Nov. 10, 2016).

[10] *See, e.g.*, John Patrick Pullen, *This Is How Drones Work*, TIME (Apr. 3, 2015), http://time.com/3769831/this-is-how-drones-work/.

and descend vertically, hover in place, navigate in any direction, and perform extremely precise movements and acrobatic maneuvers at low or high speeds.[11] Some operate via a special radio controller, while others are controlled using smartphones or tablet devices. This Issue Brief focuses on small UAS, or "microdrones," which are generally a few feet wide or smaller and weigh less than fifty-five pounds.[12]

Since most drones require onboard computational systems, it is relatively easy to add other control features. For example, the ability to hover automatically is common, especially with models that use Global Positioning Systems (GPS) to enhance navigation.[13] This allows many drones to automatically navigate to specific locations, orbit fixed points, carry out pre-drawn flight paths, or stay within certain preset boundaries.[14] They can automatically avoid sensitive locations like airports.[15] Manufacturers and operators can even set speed and altitude restrictions.[16] Some models possess sophisticated software that gives them the ability to autonomously follow, orbit, and record their operators as they bike, surf, ski, or work.[17] The most advanced systems are increasingly capable of fully autonomous flight using sense-and-avoid programs to detect obstacles and navigate using image processing software.[18]

The smallest drones are often just toys, controlled with a very simple remote or a smartphone, offering flight times of around five minutes, and are available for under $50 or $100.[19] More advanced drones, costing a few hundred dollars, offer flight times around ten minutes per charge and come with high quality cameras and some automation features.[20] Higher end consumer models, costing around $1,000 or $2,000,

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[11] *See generally* Raffaello D'Andrea, *The Astounding Athletic Power of Quadcopters*, TED (June 2013), https://www.ted.com/talks/raffaello_d_andrea_the_astounding_athletic_power_of_quadcopters.

[12] *See infra* Part II.B.

[13] Henry H. Perritt, Jr. & Eliot O. Sprague, *Law Abiding Drones*, 16 COLUM. SCI. & TECH. L. REV. 385, 422 (2015).

[14] *Id.*

[15] *Id.* at 423.

[16] *Id.* at 422.

[17] *See, e.g.*, 3D Robotics, *The IRIS+ Personal Drone - Available Now!*, YOUTUBE (Sept. 8, 2014), https://www.youtube.com/watch?v=_yOCTgVqmeQ.

[18] *See, e.g.*, Evan Ackerman, *MIT Drone Flies Autonomously While Avoiding Obstacles*, IEEE SPECTRUM (Nov. 3, 2015), http://spectrum.ieee.org/automaton/robotics/aerial-robots/mit-drone-avoids-obstacles.

[19] *See, e.g.*, *Best Drones For Sale and Why*, MYFIRSTDRONE.COM, http://myfirstdrone.com/tutorials/buying-guides/best-drones-for-sale/ (last updated Oct. 1, 2016).

[20] *See, e.g.*, *id.*

have operating times around twenty minutes, stabilized camera systems, and software that provides semi-autonomous navigation and precision flight.[21] Industry grade models and highly tailored systems for longer flight times, durability, and data analytics are also available at higher price ranges.[22]

Drones' maneuverability, small size, and ability to operate without a human onboard create a vast array of potential uses. Perhaps surprisingly, the vast majority of these uses involves low altitude flight over a localized area, perhaps a single parcel of land or a few adjoining parcels. As discussed in later parts of this Issue Brief, this is a marked difference between small drones and traditional aviation, which generally involves traversing great distances at higher altitudes and speeds.

Individuals use drones for toys, but also for capturing stunning videos of nature and recreational activities.[23] For years, Hollywood has utilized drone technology in movies filmed abroad, and recently in the United States as well.[24] Security systems are available that can detect individuals entering a piece of property and automatically launch a drone to record and follow the intruder.[25] Real estate brokers and developers use drones to capture beautiful footage and photographs of their properties.[26] Drones even assist wait staff in the food service industry by delivering meals to individual tables.[27]

Academic researchers see a number of uses for the technology. Geologists use drones to monitor dangerous sites like volcanoes.[28]

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[21] *See, e.g.*, *id.*

[22] *See, e.g.*, *Technical Specifications - AERIGON IAH 3 Helicopter*, INTUITIVE AERIAL, http://www.intuitiveaerial.com/specs/ (last visited Oct. 1, 2016).

[23] *See, e.g.*, Epic Drone Videos, *The Best Ever Drone Videos - October 2015*, YOUTUBE (Oct. 30, 2015), https://www.youtube.com/watch?v=1uym9Gb6CdM.

[24] BILL CANIS, CONG. RESEARCH SERVICE, UNMANNED AIRCRAFT SYSTEMS (UAS): COMMERCIAL OUTLOOK FOR A NEW INDUSTRY 11 (2015), https://www.fas.org/sgp/crs/misc/R44192.pdf.

[25] Tim Hornyak, *Secom Security Drone follows, Photographs Intruders*, PCWORLD (May 22, 2015), http://www.pcworld.com/article/2925912/secom-security-drone-follows-photographs-intruders.html.

[26] CANIS, *supra* note 24, at 10.

[27] Hongzuo Liu, *Drone Waiters are Ready to Serve in Singapore*, CNET (Feb. 17, 2015), http://www.cnet.com/news/singapore-has-drone-waiters-ready-to-take-your-order/.

[28] *See, e.g.*, S. Amici et. al., *Volcanic Environments Monitoring by Drones Mud Volcano Case Study*, XL-1/W2 INT'L ARCHIVES OF THE PHOTOGRAMMETRY, REMOTE SENSING AND SPATIAL INFORMATION SCI. , 5 (2013), http://www.int-arch-photogramm-remote-sens-spatial-inf-sci.net/XL-1-

Ecologists and environmental groups use them for wildlife tracking and conservation efforts.[29] Meteorologists and climate scientists also increasingly deploy drones for weather monitoring and hurricane research.[30]

Utility companies and the oil and gas industry see the value of drones to inspect and monitor towers, cables, and pipelines.[31] They also foresee using drones to conduct repairs when it is difficult or dangerous for workers to do so, like after natural disasters.[32] The Japanese government deployed drones after the Fukushima nuclear power plant incident to go places where humans could not.[33] The construction industry uses drones to significantly reduce the cost and complexity of surveying and topographical mapping.[34] They also plan to use drones to perform inspections of tall buildings and other structures that are difficult to reach, eliminating the need to put workers in dangerous positions using ropes, lifts, or scaffolding.[35]

One of the most promising uses for drone technology is in precision agriculture. Drones allow farmers to monitor their fields more regularly and at far lower cost than traditional aviation methods.[36] This allows farmers to gather "detailed data on soils, crops, nutrients, pests, moisture, and yield to increase farm productivity."[37] Larger drones already apply pesticides to crops.[38] The potential for targeted application of pesticides and fertilizers will only increase as drone monitoring takes off and automation capabilities improve.

W2/5/2013/isprsarchives-XL-1-W2-5-2013.pdf (using a small drone to test use of UAVs to monitor volcano environments).

[29] *See e.g.*, Lian Pin Koh & Serge A. Wich, *Dawn of Drone Ecology: Low-Cost Autonomous Aerial Vehicles for Conservation*, 5 TROPICAL CONSERVATION SCI. 121 (2012), http://ugallaprimateproject.com/files/Koh_and_Wich-2012.pdf (evaluating drone use to monitor various environmental impacts of diversification).

[30] *See* UNMANNED AIRCRAFT SYSTEMS PROGRAM, NAT'L OCEANIC & ATMOSPHERIC ADMIN., http://uas.noaa.gov/ (last visited Oct. 1, 2016).

[31] CANIS, *supra* note 24, at 10.

[32] *Id.*

[33] Turza, *supra* note 5, at 344.

[34] CANIS, *supra* note 24, at 10.

[35] *Id.*

[36] *See* Chunhua Zhang, *The Application of Small Unmanned Aerial Systems for Precision Agriculture: a Review*, 13 PRECISION AGRICULTURE 693 (2012).

[37] CANIS, *supra* note 24, at 10.

[38] *U.S. Approves Drone for Spraying Crops*, THE WALL STREET JOURNAL (May 5, 2015), http://www.wsj.com/articles/u-s-approves-drone-for-spraying-crops-1430880891.

The uses described here are only a small sample of the potential applications. The possibilities are virtually limitless, and they are growing in number every day.

II. REGULATORY FRAMEWORK

A. Traditional Aviation

Justice Jackson famously said,

> Planes do not wander about in the sky like vagrant clouds. They move only by federal permission, subject to federal inspection, in the hands of federally certified personnel and under an intricate system of federal commands. The moment a ship taxies onto a runway it is caught up in an elaborate and detailed system of controls . . . Its privileges, rights, and protection, so far as transit is concerned, it owes to the Federal Government alone and not to any state government.[39]

Since Congress passed the Air Commerce Act of 1926[40] and the Civil Aeronautics Act of 1938,[41] the federal government claims "complete and exclusive national sovereignty" in its airspace and grants all citizens a public right of transit through the "navigable airspace."[42] Navigable airspace encompasses all the air above the traditional minimum safe altitude of flight, defined by regulation as 500 feet in uncongested areas, 1,000 feet in congested areas, and the air below these boundaries needed for takeoff and landing around airports.[43] Thus, airspace above these lines is an open access commons regulated under similar authority as the nation's navigable waterways.[44]

Over the most sensitive locations, flight is restricted or prohibited altogether, but otherwise airspace is divided into six classes.[45] Airspace greater than 18,000 feet above mean sea level is Class A airspace.[46] Class B airspace surrounds the busiest airports up to 10,000 feet.[47] Class C airspace surrounds smaller airports up to 4,000 feet,[48] and Class D airspace surrounds the smallest airports up to 2,500 feet.[49] Class E airspace

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[39] Nw. Airlines v. Minn., 322 U.S. 292, 303 (1944).
[40] Air Commerce Act of 1926, P.L. 69-254, 44 Stat. 568 (1926).
[41] Civil Aeronautics Act of 1938, P.L. 75-706, 52 Stat. 973 (1938).
[42] United States v. Causby, 328 U.S. 256, 260 (1946).
[43] 14 C.F.R. § 91.119 (2015).
[44] *See infra* Part III.A.
[45] 14 C.F.R. § 71.9 (2015).
[46] *Id.* § 71.33.
[47] *Id.* § 71.41.
[48] *Id.* § 71.51.
[49] *Id.* § 71.61.

generally lies between 14,500 feet and 18,000 feet, but extends downward as low as 700 feet surrounding some Class B, C, and D airspaces.[50] Finally, Class G is all the other space, called "uncontrolled airspace."[51] Each type has its own set of rules that all aircraft must follow while inside.[52]

The FAA also regulates the various objects in the nation's airspace. For traditional aircraft, the FAA requires a "type certificate" covering the specifications and design[53] and a separate "airworthiness certificate" for each individual aircraft.[54] The agency will only grant these certificates if the aircraft meets detailed reliability and safety standards.[55] The FAA also promulgates training and licensing standards that govern the pilots and instructors wishing to use the navigable airspace,[56] as well as the air traffic controllers, mechanics, and engineers.[57]

Model aircraft have always been the major exception to this comprehensive regulatory scheme. Model airplanes and their operators are not subject to any of the training requirements and airworthiness standards previously mentioned, and the FAA has never promulgated a regulation specific to them. Instead, modelers have operated under the guidance of community organizations and a nonbinding advisory document from the agency, Advisory Circular 91-57.[58] This document *recommended* that flight remain below 400 feet, that modelers give right of way to full-scale aircraft, and that they notify airport operators when flying within three miles of an airport.[59] The typical model aircraft, which used to be called radio controlled (RC) planes, fit the basic definition of drones. Older RC craft differ only in their design and control systems from the newest technology described in this Issue Brief. The distinction between highly

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[50] *Id.* § 71.71.
[51] *See* FEDERAL AVIATION ADMIN., PILOT'S HANDBOOK OF AERONAUTICAL KNOWLEDGE 14-2 (2008), http://www.faa.gov/regulations_policies/handbooks_manuals/aviation/pilot_handbook/.
[52] *Id.*
[53] 14 C.F.R. §§ 21.11–55 (2015).
[54] *Id.* §§ 21.171–199.
[55] *Id.* § 23.
[56] *Id.* § 61.
[57] *Id.* § 65.
[58] R.J. VAN VUREN, FED. AVIATION ADMIN., ADVISORY CIRCULAR 91-57 MODEL AIRCRAFT OPERATING STANDARDS (June 9, 1981), http://www.faa.gov/documentLibrary/media/Advisory_Circular/91-57.pdf; *see also* ELIZABETH L. RAY, FED. AVIATION ADMIN. ADVISORY CIRCULAR 91-57A MODEL AIRCRAFT OPERATING STANDARDS (Sept. 2, 2015), https://www.faa.gov/documentLibrary/media/Advisory_Circular/AC_91-57A.pdf, (updated version of the original advisory document).
[59] *Id.*

regulated traditional aircraft and unregulated model aircraft is still important because most drones are the descendants of, and largely synonymous with, model aircraft.

B. UAS Integration

There is a crucial regulatory distinction between small UAS use for commercial purposes versus recreational purposes. This means, for example, that completely different regulatory requirements apply to each type of operator, even if they use the same physical craft and conduct the same flight patterns in the same location.

1. Commercial Drone Regulation

In February of 2007, responding to the rise of small UAS, the FAA issued a "Notice of Policy" that effectively imposed a moratorium on drone use for any commercial purposes.[60] The document was not a binding regulation, but instead sought to explain the agency's position on small UAS based on existing rules. Under the agency's logic, recreational use was permissible in accordance with the historical exception for model aircraft.[61] However, the FAA required commercial users of the same craft to receive airworthiness certificates before they could legally operate, and the agency was not issuing those certificates for small UAS.[62] Drone enthusiasts were highly critical of the policy, but the FAA threatened hefty fines and initiated numerous controversial enforcement proceedings.[63]

In 2012, Congress enacted the FAA Modernization and Reform Act.[64] The statute instructed the FAA to assess the safety concerns around drones and conduct rulemaking to integrate small UAS into the national airspace system.[65] The FAA took few steps regarding small UAS integration for several years. It left the moratorium in place, which only allowed commercial UAS flights when the agency granted a special waiver to a specific operator.[66]

Finally, in February of 2015, the agency proposed a system of generally applicable requirements that would allow small commercial

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[60] Unmanned Aircraft Operations in the National Airspace System, 72 Fed. Reg. 6689, 6689 (Feb. 13, 2007).
[61] *Id.*
[62] *Id*. at 6690.
[63] *See, e.g.*, Miriam McNabb, *The FAA's Drone Fines: How Much – and for What?*, DRONELIFE.com (June 3, 2016), http://dronelife.com/2016/06/03/33173/.
[64] FAA Modernization and Reform Act of 2012, Pub. L. No. 112-95, 126 Stat. 11.
[65] *Id.*
[66] *Id*. § 333.

UAS to operate lawfully.[67] The Notice of Proposed Rulemaking sought comments from the public and the agency considered the rules and feedback. In June of 2016, the FAA issued final regulations, which became effective on August 29, 2016.[68] There were a few changes, but most of the major final requirements are the same as those contained in the proposed rulemaking.

Unmanned aircraft must weigh less than 55 pounds.[69] They can operate only in daylight and must remain in visual line of sight of the operator.[70] Unfortunately, therefore, fully autonomous, pre-programmed flight, a most promising capability for the industry, is not permitted. While first-person camera views can be used to pilot the craft, other means must be used to sense-and-avoid obstructions and other aircraft.[71] Operators must ensure that flight remains below 400 feet elevation and less than 100 mph groundspeed.[72]

The operators of small commercial UAS must be at least 16 years old and possess a new "remote pilot certificate."[73] Operators can acquire this certification by passing a thorough aeronautical knowledge test administered by the FAA and completing a vetting process from the Transportation Security Agency.[74] Traditional aircraft pilots can also qualify as remote pilots if they complete a brief online UAS training course.[75]

2. Recreational Drone Regulation

For nearly 35 years, members of the public operated small remotely piloted aircraft for recreational purposes under policy guidance from the FAA, known as AC 91-57, which exempted them from all the traditional aircraft certification requirements.[76] In 2012, Congress took

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[67] Operation and Certification of Small Unmanned Aircraft Systems, 80 Fed. Reg. 9544 (Feb. 23, 2015).
[68] Operation and Certification of Small Unmanned Aircraft Systems, 81 Fed. Reg. 42064 (June 28, 2016) (to be codified at 14 C.F.R. pt. 107).
[69] *Id*. at 42066.
[70] *Id*.
[71] *Id*.
[72] *Id*.
[73] *Id*. at 42067.
[74] *Id*.
[75] *Id*.
[76] *See* R.J. VAN VUREN, FED. AVIATION ADMIN., ADVISORY CIRCULAR 91-57 MODEL AIRCRAFT OPERATING STANDARDS (June 9, 1981), http://www.faa.gov/documentLibrary/media/Advisory_Circular/91-57.pdf; *see also* ELIZABETH L. RAY, FED. AVIATION ADMIN. ADVISORY CIRCULAR 91-57A MODEL AIRCRAFT OPERATING STANDARDS (Sept. 2, 2015), https://www.faa.gov/documentLibrary/

note of this longstanding "model aircraft" exemption when it specifically prohibited the FAA from promulgating "any rule or regulation regarding a model aircraft" that met statutory requirements mirroring those of AC 91-57.[77]

Despite this seemingly clear congressional mandate codifying the longtime exemptions for model aircraft, on December 16, 2015, the FAA promulgated an Interim Final Rule, without notice and comment, containing a new registration requirement for model aircraft.[78] Under the new rule, all owners of small UAS weighing between .55 and 55 pounds must first register through an online system and pay fees, even if they only operate as recreational model aircraft.[79] Furthermore, in order to register, an individual must be at least 13 years of age, which prohibits younger operators from piloting model aircraft without first having someone older register for them.[80] Beyond this new registration requirement, however, recreational operators are still exempt from the other regulations governing commercial UAS flight, as long as they meet the definitions of model aircraft in AC 91-57.[81]

III. REVISITING AIRSPACE OWNERSHIP AND THE LIMITS OF FAA AUTHORITY

A. The Commerce Clause

Many drone enthusiasts and several scholars have expressed doubts about the FAA's authority over certain UAS activities.[82] For example, Professor Takahashi argues that "federal regulation of the

media/Advisory_Circular/AC_91-57A.pdf, (updated version of the original advisory document).

[77] FAA Modernization and Reform Act of 2012, Pub. L. No. 112-95, 126 Stat. 11, Sec. 336.

[78] Registration and Marking Requirements for Small Unmanned Aircraft, 80 Fed. Reg. 78594 (Dec. 16, 2015) (to be codified at 14 C.F.R. pt. 48)

[79] *Id*.

[80] *Id*. at 78595.

[81] *See* R.J. VAN VUREN, FED. AVIATION ADMIN., ADVISORY CIRCULAR 91-57 MODEL AIRCRAFT OPERATING STANDARDS (June 9, 1981), http://www.faa.gov/documentLibrary/media/Advisory_Circular/91-57.pdf; *see also* ELIZABETH L. RAY, FED. AVIATION ADMIN. ADVISORY CIRCULAR 91-57A MODEL AIRCRAFT OPERATING STANDARDS (Sept. 2, 2015), https://www.faa.gov/documentLibrary/media/Advisory_Circular/AC_91-57A.pdf, (updated version of the original advisory document).

[82] *See* Troy A. Rule, *Airspace in an Age of Drones*, 95 B.U. L. REV. 155, 164 (2015) (acknowledging the controversy regarding the proper scope of FAA authority and expressing doubt regarding jurisdiction over drones operating only a few feet off the ground).

operation of hobbyist, radio-controlled aircraft probably exceeds Congress's commerce power,"[83] and that "current jurisprudence seems to indicate that new federal regulation of non-commercial drone operations in uncontrolled non-commercial airspace could be challenged as an act that exceeds the Commerce power of Congress."[84] Other scholars have noted that "how far the federal government can go, or, more precisely, how low the federal government can go for purposes of aviation regulation, remains a highly contested question."[85]

FAA's authority over aviation derives from Congress's power "[t]o regulate Commerce . . . among the several States . . ."[86] Under the Supreme Court's commerce clause jurisprudence, there are three categories which the federal government may regulate: (1) the "channels" of interstate commerce; (2) the "instrumentalities" or persons and things in interstate commerce; and (3) those activities that "substantially affect" interstate commerce.[87] The Air Commerce Act of 1926 declared that the nation's "navigable airspace," later defined as that above 500 feet in uncongested areas and 1,000 feet in congested locations, was in the public domain.[88] Airspace was treated like the nation's "navigable waters,"[89] which are the classic "channels" of interstate commerce.

Therefore, the overwhelming majority of federal aviation regulations are uncontroversial exercises of the commerce power. The nation's navigable airspace is a channel of interstate commerce, so the federal government has the power to restrict or limit the use of the channel to those people and craft that meet certain criteria. Since most traditional flights traverse great distances and require frequent interstate crossings, the aircraft, airmen, and cargo are also instrumentalities, or things in interstate commerce.[90] Finally, traditional aviation is such a large interstate industry that it surely has substantial effects on interstate commerce, the third prong of the commerce power.

Drones complicate this picture. Unlike traditional aircraft, not all drone flights traverse great distances and involve high altitudes in public airspace. Determining the limits of federal authority for small drone

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[83] Timothy T. Takahashi, *Drones in the National Airspace*, 77 J. AIR L. & COM. 489, 521 (2012).
[84] Timothy T. Takahashi, *The Rise of the Drones - the Need for Comprehensive Federal Regulation of Robot Aircraft*, 8 ALB. GOV'T L. REV. 63, 93 (2015).
[85] Robert A. Heverly, *The State of Drones: State Authority to Regulate Drones*, 8 ALB. GOV'T L. REV. 29, 38–39 (2015).
[86] U.S. Const. art. I, § 8, cl. 3.
[87] Gonzales v. Raich, 545 U.S. 1, 16–17 (2005).
[88] *See* Air Commerce Act of 1926, Pub. L. No. 69-254, 44 Stat. 568 (1926).
[89] *See generally* Gibbons v. Ogden, 22 U.S. 1, 3 (1824).
[90] *See generally* United States v. Ballinger, 395 F.3d 1218 (11th Cir. 2005).

flights, therefore, requires careful distinctions between types of flights and types of regulations.

First, if a drone operates in the navigable airspace or crosses state lines, it is an instrumentality of interstate commerce within a channel of interstate commerce, and therefore clearly subject to federal jurisdiction. But if it is not operating in this way, it is not subject to federal authority under those prongs. I discuss the boundaries of the interstate channel in Subpart B below, and apply them to drones in Subpart C.

Second, if a drone is not in a channel and is not an instrumentality of interstate commerce, it can only be subject to federal authority under the substantial effects prong of the commerce power. I summarize the substantial effects doctrine here, and apply it to drones in Subpart C.

In *Wickard v. Filburn*, the Supreme Court recognized federal authority to restrict the private consumption of goods subject to price controls, because wheat farmers' home-consumption was of sufficient volume and variability (greater than 20% of annual production) to disrupt the national market price.[91] In *Gonzales v. Raich*, the Court upheld the federal ban on marijuana possession and use, even as applied to marijuana grown and consumed in the home.[92] The commerce clause granted power to the federal government over those local, noncommercial activities because the "failure to regulate that class of activity would undercut the regulation of the interstate market in that commodity."[93] But in *United States v. Lopez*, the court rejected federal authority over the act of possessing a gun in a school zone, because it was not tied to any market and was therefore "in no sense an economic activity that might, through repetition elsewhere, substantially effect any sort of interstate commerce."[94] And in *United States v. Morrison*, the Court struck down a federal law punishing gender-motivated violent crimes, conduct it found was not economic activity or part of any interstate market, and any "attenuated effect" on employment, production, or transit was insufficient to bring it within the limits of the commerce power.[95]

While the FAA does not currently appear concerned that these precedents place limits on its own authority, the historical hands-off approach to low flying model aircraft and noncommercial drone use can be best understood with these cases in mind. Perhaps Congress and the FAA have always left modelers alone purely because they did not see a

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[91] Wickard v. Filburn, 317 U.S. 111, 127–28 (1942).
[92] Gonzales v. Raich, 545 U.S. 1, 21–22 (2005).
[93] *Id.* at 2.
[94] United States v. Lopez, 514 U.S. 549, 567 (1995).
[95] United States v. Morrison, 529 U.S. 598, 616 (2000).

need to regulate them, but perhaps they were also trying to steer clear of the outer limits of their authority.

B. *United States v. Causby*

As discussed above, federal authority is determined in part by the boundaries of the channels of interstate commerce. This boundary between public and private airspace is a question that has remained largely unanswered for seventy years.

The common law system of airspace rights was called the *ad coelum* doctrine, based on the Roman maxim, "*cujus est solum, ejus est usque ad coelum*," which meant that whoever owns the land also owns all the space up to the heavens.[96] This unlimited airspace ownership theory came into direct conflict with the rising aviation industry because this theory would give landowners the right to prevent overflights under trespass law. The Supreme Court addressed this problem in the 1946 case, *United States v. Causby*.[97]

In Greensboro, North Carolina, the Causbys owned a chicken farm near an airport used by navy aircraft. The descent angle for landing planes passed "over their property at 83 feet, which is 67 feet above the house, 63 feet above the barn and 18 feet above the highest tree."[98] The noise from the landing planes was so loud that farm production declined and over 150 chickens died from fright, often from flying into walls.[99] The Causbys argued the flights constituted an unlawful taking of their property prohibited by the Fifth Amendment.[100]

Justice Douglas, writing for the Court, said "common sense revolts at the idea" of transcontinental flights being the subject of countless trespass suits, concluding instead that the *ad coelum* doctrine "has no place in the modern world."[101] The Court, however, also believed landowners "must have exclusive control of the immediate reaches of the enveloping atmosphere" because if they did not, then "buildings could not be erected, trees could not be planted, and even fences could not be run."[102] And yet the Court clearly held, "The [navigable airspace] is a public highway, as Congress has declared."[103] This compromise established a distinction

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[96] Colin Cahoon, *Low Altitude Airspace: A Property Rights No-Man's Land*, 56 J. AIR L. & COM. 157, 161 (1990).
[97] United States v. Causby, 328 U.S. 256 (1946).
[98] *Id.* at 258.
[99] *Id.* at 259.
[100] *Id.* at 258.
[101] *Id.* at 261.
[102] *Id.* at 264.
[103] United States v. Causby, 328 U.S. 256, 261 (1946).

between private airspace ownership at low-altitude and public airspace at all higher altitudes. Rather than precisely defining this border, the Court used terms like "immediate reaches" and the "superadjacent airspace" as flexible descriptors.[104] While the Court did not question the 500 or 1,000 foot "navigable airspace" border established by Congress through the agency, it clearly warned that a hypothetical lower border, like 83 feet, "would have presented the question of the validity of the regulation" for exceeding federal power.[105]

At least two lessons are clear from *Causby*. First, "[t]he airspace, apart from the immediate reaches above the land, is part of the public domain"[106] and as a result, within the power of Congress to regulate as a channel of interstate commerce. Second, the landowner owns the "immediate reaches" or the "superadjacent airspace," which includes "at least as much of the space above the ground as he can occupy or use in connection with the land."[107] Federal authority within this space, wherever its boundary lies, is more limited.

C. Applying the Commerce Clause and the Lessons of Causby

The application of the Supreme Court's logic raises serious doubts about the validity of FAA's drone regulatory efforts. First, low-altitude, local, small UAS flight outside controlled airspace, *for either commercial or hobby purposes* is beyond the scope of the channels and instrumentalities prongs of the commerce power. A real estate developer or filmmaker flying a small UAS at 100 feet (or perhaps all the way up to the 500 feet "navigable" border) is no more subject to federal regulation under these prongs than a model aircraft operator. Since many of the most important commercial drone uses fall into this category, the FAA's moratorium and new regulations of commercial drone flights must be justified under the third prong.

Second, low-altitude, local, small UAS flight outside controlled airspace *for hobbyist, recreational, or private purposes* is probably beyond the federal government's authority even under the substantial effects prong of the commerce power. These drone flights look more like the noneconomic activities addressed in *Lopez* and *Morrison* than the commodities addressed in *Wickard* and *Raich*.[108] There is no regulation of an interstate market that this activity could undermine. No good is consumed, so the frequency of these flights, even in the aggregate, would not appear to change the price or volatility of any commodity. These

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[104] *Id.* at 265.
[105] *Id.* at 263.
[106] *Id.* at 266.
[107] *Id.* at 264.
[108] *See supra* Part III.A.

flights could perhaps have substantial effects on the traditional aircraft industry itself if they interfered with larger aircraft, but at best this could only extend federal authority to cover drone operations near an airport or restricted airspace. That justification probably does not extend to a rural recreational operator flying in his or her own yard at low altitude. For this reason, the new registration requirement for model aircraft is highly suspect, because it covers *anyone* purchasing and operating a small drone at *any* altitude in *any* location in America.[109] Courts could very well overturn this regulation for exceeding the bounds of federal authority under the commerce clause. Unsurprisingly, the Interim Final Rule requiring model aircraft registration already faces at least one legal challenge in the courts.[110]

Indeed, under this logic it would appear the federal government could just as easily regulate anything from paper airplanes to bird owners. The Court has long warned against interpretations that extend so far "as to embrace effects upon interstate commerce so indirect and remote that to embrace them, in view of our complex society, would effectually obliterate the distinction between what is national and what is local and create a completely centralized government."[111]

Third, low-altitude, local, small UAS flight outside controlled airspace *for commercial purposes* is a closer call, but may still lie beyond the federal government's authority under the "substantial effects" prong. If two operators fly similar low-altitude local flights while capturing video and one sells that video while the other does not, that operator does not automatically fall within the power of federal regulation under the commerce power simply because she sold something. The federal government has the power to regulate *interstate commerce*, not *all commerce everywhere*. A single commercial transaction does not necessarily imply substantial effects on interstate commerce. Congress can certainly regulate those flights that cross state borders or flights used for interstate transactions, but it can only regulate *intra*state flights for *intra*state transactions if there is a substantial effect on some *inter*state market.[112] At least at this time, courts would probably be skeptical of federal restrictions simply because the operator had some kind of economic motivation.

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[109] *See supra* Part II.B.2.

[110] *See* Taylor v. Huerta, Case No. 15-1495, (D.C. Cir. filed Aug. 4, 2016). At the time of this writing, the suit challenges the administrative procedure of the rule – specifically the FAA's failure to comply with notice-and-comment rulemaking requirements – rather than a violation of constitutional limits.

[111] NLRB v. Jones & Laughlin Steel Corp., 301 U.S. 1, 37 (1937).

[112] *See supra* Part III.A.

Fourth, the rise of drones might actually restrict federal authority over low-altitude airspace under the channels and instrumentalities prongs. Recall *Causby's* essential holding that a landowner's private property extends to "as much of the space above the ground as he can occupy or use in connection with the land."[113] Low-altitude, local, drone use, especially for purposes like precision agriculture or personal property surveillance and security, at least arguably qualifies as a use of the airspace "in connection with the land." Imagine a future, perhaps only a few years away, where automated drones regularly take off, gather data on a farmer's crop health, spray at-risk areas, and return to their charging stations, all without human input. In a future where low flying autonomous drones may be as vital to farming practices as heavy tractor equipment is today, that farmer's near-surface airspace would be private property under the logic of *Causby*, just as surely as the airspace needed for grain silos is today. Therefore, a considerable portion of the debate about drone regulation gets the issue precisely backwards. The question should not be, "Can the FAA's authority reach lower, beyond the 'navigable' floor, to regulate all airspace used by drones?" Instead, the question should be "Do drones push airspace private property rights higher, limiting federal authority to those activities with substantial effects on interstate commerce?"

IV. CLEAR PROPERTY RIGHTS

Airspace has been a "property rights no-man's land" for too long.[114] The time has come to answer the questions *Causby* evaded. How high do private property rights go? How low does the public airspace "federal highway" go? The growing drone industry and its waiting customers have been grounded by this uncertainty for too long.

Without clear airspace definitions, drone operators and property owners cannot know the extent of their rights. Imagine a woman finds her neighbor standing in his yard, piloting a drone around her home. Surface property rules would give her a clear right to exclude such a remote controlled device if it were on the ground, but if it is 200, 100, 10, or even a single foot in the air, the woman and her neighbor cannot be certain of their entitlements and duties.[115] This situation might seem relatively trivial, but as more individuals and businesses begin using drones, perhaps even for deliveries, these conflicts will grow more frequent and more serious. Property lines play a crucial role in defining the limits of federal authority, as already shown, and the economic and theoretical justifications for a clear property regime are also compelling.

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[113] United States v. Causby, 328 U.S. 256, 264 (1946).
[114] *See* Cahoon *supra* note 96.
[115] Rule, *supra* note 82, at 170.

Scholars have proposed several theoretical and economic frameworks for choosing between a clearly divided property regime, like surface rights, and a regulated commons, like waterways and high-altitude airspace.[116] Key questions include the following: How costly is it to internalize inputs and outputs?[117] Is the relevant information for productive use dispersed or centralized?[118] Are conflicts likely to involve a small number of parties or a large number?[119] For surface rights, internalization is straightforward and cheap with fences, walls, surveying equipment, and recording systems, whereas it would be extremely difficult and expensive for high altitude airspace.[120] Land is extremely versatile, which means information about the most productive use of each land parcel is dispersed among separate market actors, not centralized and uniform.[121] Conversely, high altitude airspace is extremely uniform and only used in a very small number of ways.[122] Surface land disputes usually involve a few parties nearby one another, which means the transaction costs of bargaining are relatively low compared with the masses of people overflown by transcontinental flights.[123]

Professor Troy Rule believes a regulated commons regime for low-altitude airspace was sufficient for traditional aviation, but is "considerably less tenable in an age of domestic drones."[124] He calls for greater precision in low-altitude airspace rights, like granting landowners ownership above their land to the previously established 500 foot "navigable airspace" line.[125] Many other scholars share the view that a clearer division between public and private airspace is warranted.[126] This will not only clarify trespass and takings cases, but also help solve difficult privacy issues raised by drone use. For example, a considerable amount of Fourth Amendment doctrine relating to government searches and surveillance is based on property rights, so clarifying these lines would add a layer of protection for those concerned about police drone use.[127]

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[116] *Id.* at 174.
[117] *Id.* at 176.
[118] *Id.* at 177.
[119] *Id.* at 178.
[120] *Id.* at 174–82.
[121] Rule, *supra* note 82, at 177.
[122] *Id.* at 182.
[123] *Id.* at 174–82.
[124] *Id.* at 185–86.
[125] *Id.* at 187.
[126] *See, e.g.*, Wendie L. Kellington & Michael Berger, *Why Land Use Lawyers Care About the Law of Unmanned Systems*, 37 ZONING & PLANNING L. REP. 1 (2014); Takahashi, *supra* note 84, at 127; Heverly, *supra* note 85, at 60.
[127] *See* Heverly, *supra* note 85, at 60.

Some federalism scholars support a larger role for state choices and control over their low-altitude airspace, rather than an exclusively federal regulatory system.[128] And finally, while manned flight presents overwhelming safety concerns justifying a comprehensive federal scheme, there is little reason or evidence to suggest state tort and property law are insufficient to manage the safety risks from small UAS that only weigh a few pounds and measure a few feet wide.

CONCLUSION

The FAA's statements and recent regulatory decisions indicate that it believes federal jurisdiction over airspace extends all the way to the surface, but drone enthusiasts and many scholars disagree. The UAS rules are a step in the right direction from the questionable 2007 moratorium and waiver process because they are a meaningful effort to accommodate the rising demand for drones. However, the regulations will likely face serious legal challenges before they fully get off the ground.

There are limits to federal power under the Commerce Clause, and some of the most important drone uses lie at or beyond the outer edge of that authority. The FAA would do well to take a more hands-off approach to low-altitude local drone use, and focus on delivery drones, or other uses that involve greater distances at higher altitudes and more sophisticated traffic patterns. It should generally police small UAS only to the extent they operate inside controlled airspace with traditional aircraft or regularly cross property boundaries at significant altitudes and speeds, like traditional aircraft.

Causby's cloudy compromise between high altitude federal commons and private surface rights is no longer workable. States can assist in this area by asserting the property rights the Supreme Court recognized but did not define. However, the FAA or Congress will most likely need to make a course correction and clarify property right boundaries in low-altitude airspace. Instead of hampering the domestic drone industry and its users with uncertainty and overreach, each level of government should move quickly to do what it can to help this technology take off.

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[128] *See generally* Margot E. Kaminski, *Drone Federalism: Civilian Drones and the Things They Carry*, 4 CAL. L. REV. CIRCUIT 57 (2013).