METAR SMS Text Message Service to Support Part 107 Compliance: A Classroom Lab Exercise

JOSEPH M. BURGETT[1]

[1]Nieri Department of Construction Development and Planning, Clemson University, 2-134 Lee Hall, Clemson SC, 29631 United States of America

**jmburg@clemson.edu*

Abstract: Unmanned aircraft systems (UAS) have been used to support a wide range of industries. Code of Federal Regulations Title 14 Part 107 provides the rules that govern most commercial UAS missions. Section 107.51 of the regulations limits the maximum UAS altitude to 400 feet above the ground or structure and a minimum clearance of 500 feet below clouds. The required cloud clearance is often easy to comply with as most cloud coverage is thousands of feet above the ground and well above the 400-foot ceiling. However, many missions require the UAS to fly nearly low-altitude clouds or early morning fog. In these situations, the pilot must know the altitude of the clouds to maintain the necessary clearance. Accurately estimating cloud height visually is very difficult to do. However, the Federal Aviation Administration (FAA) has partnered with Leidos Flight Services to develop an SMS text service through the 1800wxbrief.com service to receive real-time Meteorological Aerodrome Report (METARs) weather reports in plain text. This paper shows how this new tool can be used to determine cloud height and incorporate it into a classroom activity to support Part 107 compliance.

Keywords: Part 107, Unmanned Aircraft System, drones, METAR, cloud

Introduction

Unmanned aircraft systems (UAS), colloquially referred to as "drones," are a tool that has seen significant growth over the past decade. Drones currently support various industries, including construction, law enforcement, agriculture, and cinematography [1]. The rapid growth of drone use started with the release of the Code of Federal Regulations Title 14 Part 107 (Part 107) in 2016 [2] and is the "default regulation for drones weighing under 55 pounds" [3]. Part 107 provides specific requirements governing lawful UAS operations, including a maximum of 400ft above ground level altitude, limitations of flights over people, and additional lighting requirements for night operations. This rapid communication manuscript will focus on section 107.51.d.1. The regulation requires remote command pilots (RPICs) to maintain a minimum 500-foot buffer below clouds. The purpose is to give RPICs sufficient space to avoid crewed aircraft operating in a cloud where visibility is reduced.

- *Section 107.51: A remote pilot in command and the person manipulating the flight controls of the small unmanned aircraft system must comply with all of the following operating limitations when operating a small unmanned aircraft system…(d) The minimum distance of the small unmanned aircraft from clouds must be no less than: (1) 500 feet below the cloud; and (2) 2,000 feet horizontally from the cloud.*

The requirement to maintain a minimum of 500 feet from the underside of a cloud is a non-issue for many missions as the cloud altitude is significantly above the allowable 400ft ceiling. However, it is not unusual for a mission to occur when low-altitude clouds or early morning fog are present. RPICs must know the cloud height to know their maximum mission altitude. A challenge for many RPICs is that most commercial weather services do not provide low-level cloud altitudes. The goal of this rapid communication is to demonstrate how a text messaging service from 1800wxbrief.com by Leidos Flight Services can help meet the requirements of Section 107.51 and be integrated into a field exercise for a collegial UAS training program.

Background

Part 107 requires pilots to pass a knowledge test before earning their remote pilot certificate. A skill assessed with the knowledge test is reading a meteorological terminal air report (METAR). The FAA defines a METAR as "observation of current surface weather reported in a standard international format" [4]. Unlike many commercial weather reports, the METAR provides cloud height information.

METAR

The METAR below is the example used in the FAA's Pilot's Handbook of Aeronautical Knowledge (FAA-H-8083-25B, chapter 13) [5].

- *METAR KGGG 161753Z AUTO 14021G26KT 3/4SM +TSRA BR BKN008 OVC012CB 8/17 A2970 RMK PRESFR*

METARs are issued every hour and always report the amount, height above ground level (AGL), and the presence of towering cumulus (TCU) or cumulonimbus (CB) clouds [5]. As such, the METAR can be useful for RPICs to maintain the 500-foot buffer from low-altitude clouds. In the example above, "BKN008" means broken clouds at 800ft. "OVC012CB" means the skies are overcast at 1,200ft with cumulonimbus clouds.

There are two challenges for UAS pilots using the METAR. First, while knowing how to read the METAR is required for the Part 107 exam, most UAS pilots don't commonly use it, and the skill is quickly lost. The second challenge is that accessing current METAR either by radio frequencies of nearby airports or through an internet connection may require additional equipment (radio, computer, internet access, etc.) and be inconvenient during hot and dusty conditions associated with fieldwork.

Laboratory Activity

Leidos Flight Services is an FAA partner and service provider of 1800wxbrief.com. Recently, the 1800wxbrief.com service began offering real-time METAR forecasts as a text message service, which addresses both challenges. Users can text 358-782 in the following sequence: "M, space, and the four-letter airport code" for the METAR. You can also text "M, space, the four-letter airport code, PT" to get the METAR in plain text. See Figure 1 for an example under two separate weather conditions. Full instructions can be provided by texting "FLTSVC" to 358-782.

Laboratory Assignment

The text below describes a laboratory assignment instructor can use to incorporate this tool into their curriculum.

- *You are a Remote Pilot in Command assigned to inspect a communication tower that is 1,150ft AGL. The communication tower is located in class G airspace near the Columbia Metro (KCAE) airport in Columbia, SC. How high can you inspect the tower with a UAS, given the cloud condition reported at the airport's METAR right now? Provide evidence that supports your answer.*

There are several ways that this question can be answered; however, a straightforward solution is to text "M KCAE PT" to 358-782 to get the METAR in plain text. The question is dynamic, and the answer will vary based on the weather near the airport. The correct answer will be the lowest altitude of the cloud cover minus the 500-foot buffer. The example below is the plain text METAR from the text service. It shows the entire height of the tower can be expected as the cloud cover ceiling is at 18,000ft AGL. The maximum height that pilots can fly is 1,550ft (tower height + 400ft), which is well below the cloud deck. Additional laboratory assignments using this service are provided in the Supplemental Material.

- *Current conditions at KCAE issued Aug 15 at 1156Z. Wind from 2500 at 3 knots, 10 statute miles visibility, Few Clouds at 18,000, Temperature 270C, Dewpoint 250C, Altimeter is 29.92.*

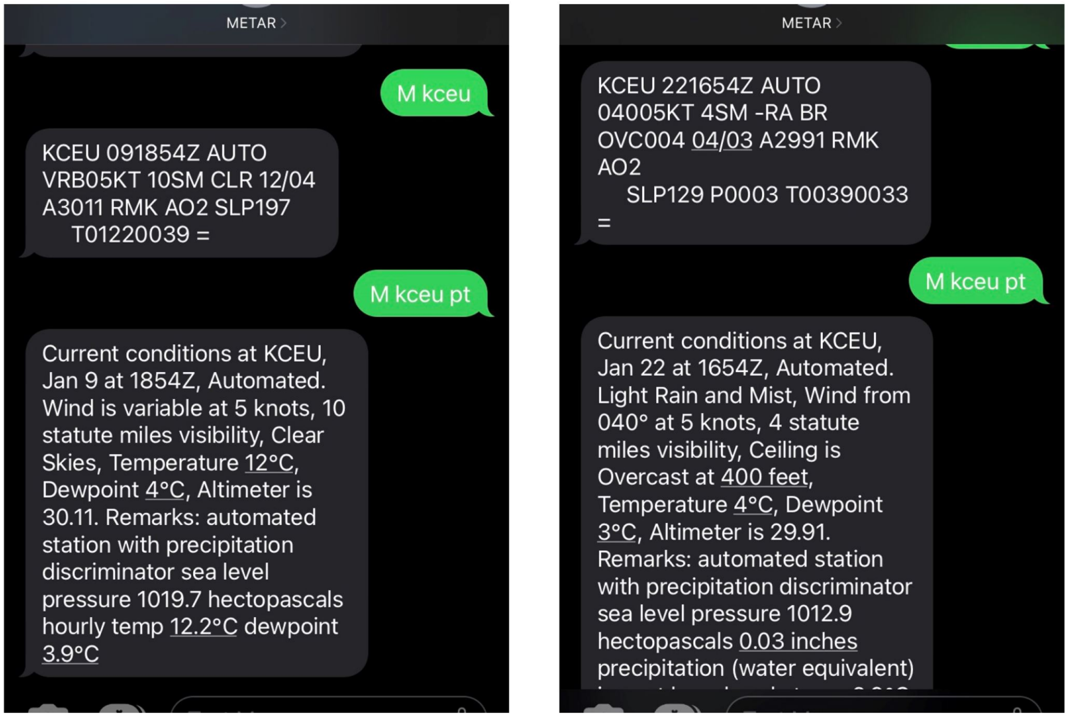

Fig. 1. Examples of the METAR text service (a) under ideal and (b) poor conditions.

The question can be varied by substituting the airport ID with one the students are familiar with. Instructors can also make checking the METAR with the text service part of their flight operations. While not the focus of this paper, this tool can also be used to help students learn how to read the METAR during the Part 107 knowledge exam prep by texting for various airports METAR, attempting to decode it by themselves, and checking their interpretation by texting for the METAR in plain text.

Learning Objective and Outcome

A "learning objective" is defined as what an instructor, activity, or class intends to do [6]. In this case, the overarching objective is for students to learn how to determine the altitude of low-level clouds to comply with Part 107 Section 107.51. The learning objective below can be a template for instructors' syllabi or assignment descriptions.

- *Learning Objective: Learn how to determine the altitude of low-level clouds to comply with the 500-foot buffer requirement of Part 107, section 107.51.*

A learning objective differs from a "learning outcome." A learning outcome describes in measurable terms what a student can do after completing an activity [6]. A vital component of a learning outcome is that it is "measurable" to be compared against a cognitive framework. Bloom's taxonomy is a common cognitive framework that divides knowledge levels into six categories: remember, understand, apply, analyze, evaluate, and create [7]. The learning outcome below provides a template instructors can use in their courses using the "evaluate" level of knowledge. Descriptions of "evaluate" include appraise, argue, defend, judge, selection, value, and critique [7].

- *Learning Outcome: Defend if current weather conditions allow for a UAS mission to be completed within the requirements provided in CRF Title 14 Part 107 section 107.51.*

Acknowledgements. This work was supported by the Nieri Department of Construction, Development and Planning at Clemson University. The author would like to thank the faculty and staff for continuing to support his research in the field of applied UAS.

Disclosures. The authors declare no conflicts of interest.

Supplement Materials: Please see https://micronanoeducation.org/wp-content/uploads/2023/10/Supplemental-Material_DOI.docx

References

[1] J. M. Burgett, "UAS Law Enforcement Technicians in South Carolina: An Exploration of Supply and Demand," *Micro Nano Technology Education Center*, vol. 2, no. 1, Mar. 2023, Accessed: Mar. 07, 2024. [Online]. Available: https://micronanoeducation.org/journal/volume-2-issue-1/uas-law-enforcement-technicians-in-south-carolina-an-exploration-of-supply-and-demand/

[2] Federal Aviation Administration, Department of Transportation, *Title 14 - Part 107 -- Small Unmanned Aircraft Systems*, vol. 14 CFR Part 107. 2016. Accessed: Mar. 07, 2024. [Online]. Available: https://www.ecfr.gov/current/title-14/part-107

[3] "Recreational Flyers & Community-Based Organizations | Federal Aviation Administration," Federal Aviation Administration. Accessed: Mar. 07, 2024. [Online]. Available: https://www.faa.gov/uas/recreational_flyers

[4] "Remote Pilot – Small Unmanned Aircraft Systems Study Guide," Federal Aviation Administration, FAA-G-8082-22, Aug. 2016. [Online]. Available: https://www.faa.gov/sites/faa.gov/files/regulations_policies/handbooks_manuals/aviation/remote_pilot_study_guide.pdf

[5] "Pilot's Handbook of Aeronautical Knowledge," Federal Aviation Administration, FAA-H-8083-25B, Aug. 2016. Accessed: Mar. 08, 2024. [Online]. Available: https://www.faa.gov/aviation/phak/pilots-handbook-aeronautical-knowledge-faa-h-8083-25b

[6] "Course Objectives & Learning Outcomes," DePaul University. Accessed: Aug. 15, 2023. [Online]. Available: https://resources.depaul.edu/teaching-commons/teaching-guides/course-design/Pages/course-objectives-learning-outcomes.aspx

[7] P. Artmstrong, "Bloom's Taxonomy," Vanderbilt University - Center For Teachings. Accessed: Mar. 08, 2024. [Online]. Available: https://cft.vanderbilt.edu/guides-sub-pages/blooms-taxonomy/