JANUARY 2022 VOL. 12, NO. 1

# In The Trenches

THE NEWS MAGAZINE OF THE NATIONAL ASSOCIATION OF GEOSCIENCE TEACHERS

## Turn Your Eyes to the Skies: Tips on Using Drones

# In The Trenches

**Editor in Chief**: Redina Finch
**Managing Editor**: Nancy Ashmore

**On the Cover:** CLOUD-MAP, an NSF-funded joint partnership between Oklahoma State University, University of Kentucky, University of Oklahoma, and the University of Nebraska-Lincoln, focuses on the development and implementation of unmanned aircraft systems (UAS) and their integration with sensors for atmospheric measurements. [Image: screenshot from the 2019 WebsEdge Science video at https://www.youtube.com/watch?v=zO4oQqWwvLg]

***In The Trenches*** **(ISSN 2372-1936)** is a quarterly magazine of the National Association of Geoscience Teachers, a professional association that works to foster improvement in the teaching of the Earth Sciences at all levels of instruction, to emphasize the cultural significance of the Earth Sciences and to disseminate knowledge in this field to the general public.

To learn more about *ITT*, visit:

http://nagt.org/nagt/publications/trenches/index.htm

**NAGT MEMBERSHIP:**
To learn more and to join NAGT, visit:
http://www.NAGT.org

**TO CONTACT US:**

**Email:** *inthetrenches@nagt.org*
Email us to send a letter to the editor or to inquire about advertising in ITT or submitting an article for a future issue. We reserve the right to edit letters for clarity and length.

**Mailing Address:**
NAGT, c/o Carleton College, B-SERC
One North College Street
Northfield, MN 55057

# IN THIS ISSUE

JANUARY 2022 / VOL. 12, NO. 1




**Building your Geoscience Community through NAGT**
**Anne Egger,** Central Washington University, NAGT Executive Director
**Rory McFadden,** Gustavus Adolphus College
**Karen Layou,** Reynolds Community College
**Adrianne Leinbach,** Wake Technical Community College
**Date: Friday, February 4, 2022**

**Exploring the Earth System with Understanding Global Change**
**Jessica Bean,** UC Berkeley Museum of Paleontology
**Date: Thursday, February 10, 2022**

**Climate Survey of the Geosciences: Disproportionate impacts on historically excluded groups**
**Erika Marin-Spiotta,** University of Wisconsin-Madison
**Date: Tuesday, February 15, 2022**

**Workshop for Early Career Geoscience Faculty**
**Application Deadline is Tuesday, March 1, 2022.**
**Date: June 20-24, 2022, with an optional virtual visit to NSF in Summer 2022. University of Maryland, College Park, MD**

**View and register for a webinar: http://nagt.org/231493**

# From the Editor

Brrr! It's cold outside… unless you're in the south, then the rest of us are jealous! Real winter has finally arrived and I'm pretty happy to see some snow. It's beautiful outside here in Illinois. I'm also happy that we're (mostly) back in the classroom for teaching. COVID is still with us, but you have to look for the silver lining around the clouds and know that rainbows will be coming in the spring.

Just a reminder that I'm still looking for articles for *In The Trenches*. If you do something innovative, interesting, or particularly effective, then I'd love to share it with our readers! This issue focuses on drones, drone rules, and my use of drones in education. By the way, the answer to the question in the image caption is—no, this picture was not taken by a drone. It's far too cold up there for drones.

I have some exciting news for *ITT*. Last January we did a trial run of a fully online version of *ITT* and it was a great success. The nice thing about the online magazine is that you can click on active links in the article and jump right to the referenced material. Our authors also have more freedom when it comes to the kinds of articles that they can submit. Authors can share links to videos (be sure they are captioned) and other course material, and the links are live in the article. Online *ITT* also allows us to host more articles without some of them being online and some in the print version. I can also have more articles of interest from committees, divisions and sections because we aren't limited by space. I'm looking forward to seeing how *ITT* evolves now that it's online.—**Redina Finch**

**A cirque glacier in Alaska's Wrangell-St. Elias National Park flows over an ice fall before joining the Fraser Glacier in the valley below. Do you think this image was taken by a drone? [NPS Photo/Jacob W. Frank]**

# New NAGT Officers Introduce Themselves

## 1ST VICE-PRESIDENT

**CHRISTY VISAGGI (cvisaggi@gsu.edu),**
**Georgia State University, Atlanta, GA**

I'm a Senior Lecturer and Undergraduate Director in the Department of Geosciences at Georgia State University, a minority-serving institution in downtown Atlanta. My research ranges from the study of fossil snails to conservation of modern biota to place-based and culturally responsive pedagogy to supporting inventory work with the National Park Service. My passion is sharing my love of science with audiences of all ages, especially via experiential learning and using the urban campus at GSU as an outdoor lab. I'm honored to have won awards for excellence in instruction, mentoring, and research with students, and have had the pleasure of co-leading several NSF REUs. I received my PhD in marine biology from the University of North Carolina in Wilmington, MS in geology from Syracuse University, and BA in geology from Colgate University.

Teaching runs in the family, and my work as an educator has included high school Earth science, summer camps ranging from music to marine science, and my current role leading science and career-focused classes for majors, non-majors, and students preparing to teach in K-12. In addition, I love participating in outreach such as for National Fossil Day or the Atlanta Science Festival. My interests in NAGT developed after engaging in professional development opportunities during my PhD, and then shortly after landing the faculty job at GSU, I was encouraged to serve as president of the Southeastern Section. I have been an active member of SENAGT for many years, and since stepping into the Vice President role, I now serve on committees dedicated to supporting sections and K-12 members, chair the Diversity, Equity, and Inclusion Committee for the Teacher Education Division, and more. I have been a long-standing advocate of NAGT's Outstanding Earth Science Teacher Award, and I hope to see even more nominations come in future years (hint, hint). You'll see me soon if you join a council meeting as my responsibilities now also include running them!

In reflecting on my NAGT experiences, I'm overjoyed at just how welcoming the community has been from the start. Being around others who are excited to get nerdy over new ways to think about learning or who are ready to fight for quality education for all is incredibly inspiring. Having "grown up" academically in paleontology, it has been unbelievably rewarding to have so many people in NAGT *believe* in me and what I do. Tears of joy in feeling valued by such outstanding educators and being able to positively contribute to this wonderful community is so fulfilling. Like many of you, managing through the pandemic, particularly while also juggling motherhood, has been extremely challenging. Being a part of NAGT leadership and working with amazing colleagues has been an ever-present ray of sunshine amidst the chaos. I am so appreciative of what NAGT has done for all of us during the never-ending pivot in our approaches, and I look forward to giving back to this exceptional organization that has done so much for me and my students.

Christy Visaggi

Alex Manda

## COUNCILOR-AT-LARGE

**ALEX MANDA (Mandaa@ecu.edu),**
**East Carolina University, Greenville, NC**

I am delighted to have been elected as a member of the NAGT Executive Committee as a Councilor-at-Large. My role in this position is to assist the Executive Committee in implementing the mission of the association to "support a diverse, inclusive,

and thriving community of educators and education researchers to improve teaching and learning about the Earth."

One of the roles that I am particularly interested in fulfilling during my tenure is that of liaison to the Southeastern Section of the NAGT. In this role, I hope to facilitate engagement and interaction between the section and the Executive Committee. This would include acting as a voice for the members of the Southeastern Section on the committee and finding ways to help support section initiatives and activities. Because sections play an important role in furthering the mission of the association, strong ties between the section and the Executive Committee are crucial for making progress towards the vision of building an Earth-literate society.

Over the years, I have greatly benefitted from various types of programs and activities that have supported the teaching of the geosciences to different student groups. For example, soon after being hired as an assistant professor at East Carolina University, I attended an "On the Cutting Edge" early career professional development workshop in Virginia; at the time, this program was funded by the National Science Foundation, but the NAGT currently helps to support this program. It was at this workshop that I had paradigm shifts concerning teaching. First, it was no longer "what do I need to teach the students?", but rather "what do the students need to learn?" and second, and most important, I adopted concepts about active learning—this idea that students are active participants in the learning process rather than passive listeners—that I still use to this day.

Dana Thomas

Although I am a "mid-career" geoscientist, I am still excited about and interested in programs that help make me a better geoscience educator. Recently, I took part in the Geodesy Tools for Societal Issues (GETSI) workshop that was supported by NAGT. This workshop focused on the use of vetted and ready-to-use teaching materials that feature geodetic data and quantitative skills that focus on societally important issues. Having access to this and other digital resources has been immensely beneficial to my educational career. I truly believe that I have become a better educator because of these programs and activities. Being part of the NAGT Executive Committee will provide me with an opportunity to "pay it forward" by ensuring that these and other resources or opportunities will continue to be made available to the next generation of geoscience educators.

## COUNCILOR-AT-LARGE

**DANA THOMAS (dthomas@jsg.utexas.edu),**
**University of Texas at Austin, Austin, TX**

As a Councilor, I hope to learn about and represent the interests of NAGT members, especially graduate students and geoscience educators who focus on co-curricular learning and broadening participation. I will be the liaison for the Eastern Section, which means I will be responsible for communicating updates, concerns, ideas, challenges and accomplishments back and forth between the section and the NAGT Executive Committee. I am inspired by the quite active nature of the Eastern Section and look forward to getting to know its leadership and members.

My involvement with NAGT has been crucially formative in my professional development. The resources I've used and the relationships I've made have helped me end up where I am today. My passions as an Earth and environmental science educator lie in doing my best to provide every student, from all backgrounds, with access to the learning, opportunities and support they need to pursue their goals. As a Senior Academic Program Coordinator in Diversity, Equity and Inclusion at the Jackson School of Geosciences at the University of Texas at Austin, I focus on developing and managing inclusive educational programs that broaden participation in geoscience, primarily at the pre-college and undergraduate levels. Current projects include a summer undergraduate research traineeship experience, a STEM bootcamp for incoming college freshmen, and a workshop series for faculty and researchers to become more inclusive mentors. I also cherish teaching, and I am a Lecturer with the Energy and Earth Resources Graduate Program at the Jackson School, incorporating societally relevant issues into geology courses.

I have always had a fondness for education that existed alongside my love for Earth science. I was

fortunate to learn of NAGT as an undergraduate at Louisiana State University and became a member when I was in graduate school at Stanford University. While at Stanford I took courses in the Education Department, was active with the Vice Provost for Teaching and Learning, and also participated in workshops through the InTeGrate project, becoming enamored with active learning. Together with fellow graduate students, I led the design and implementation of teaching and learning workshops and other TA-training initiatives, on which I presented at the 2016 Earth Educators' Rendezvous in Madison, WI. Towards the end of the poster session, a thunderstorm rolled in across Lake Mendota. A group of us remained in the room, which had picture windows overlooking the lake, to wait until it was safe to go outside. I'll never forget watching the wind pick up, the sky darken, and the clouds arrive, all while getting a scientific play-by-play from a fellow attendee—a meteorologist who was tracking the storm on radar and teaching us about it!

Please reach out if your interests align with mine, especially if you are a graduate student. I am passionate about returning the benefits I received from fellow NAGT members as I was exploring career options. I look forward to serving as a Councilor!

## THE OUTSTANDING EARTH SCIENCE TEACHER (OEST) AWARDS

### Recognizing Exceptional Contributions to the Stimulation of Interest in the Earth Sciences at the Pre-college Level

**MIGHTY OAKS FROM LITTLE ACORNS GROW... and future Earth scientists grow from K-12 students inspired by exceptional teachers.** Excellent elementary, middle school, and high school educators deserve recognition at all times, but that is especially true now, when their work, always challenging, has been complicated by the need to deal with the impacts of a pandemic. NAGT honors dedication of this sort by presenting OEST Awards to ten national finalists, one from each NAGT regional section. Some sections also recognize state winners.

**Any teacher or other K-12 educator who covers a significant amount of Earth science content with their students is eligible.** Individuals may also apply themselves. Winners are recognized in the October issue of *In the Trenches* and at the annual gathering of the Education Division of the Geological Society of America.

**NOMINATION DEADLINE: MARCH 31, 2022**

**TO LEARN HOW TO NOMINATE AN INSPIRING TEACHER:**
https://nagt.org/nagt/awards/oest.html

# Using Drones in Education: Things to Consider Before You Launch

Drones can be incredibly useful tools for studying things from vantage points that are difficult or dangerous to access, whether you're monitoring gray whale calf production or measuring how the temperature and moisture profile over a lake varies with time of day and weather. Inset: The Swellpro Splash Drone 3+ being used at Western Illinois University [Photos by the National Oceanic and Atmospheric Administration and Redina Finch]

Drones are fun! They are also good tools for teaching if you're trying to learn about a place you can't reach any other way. Depending on your application, drones can also teach students geospatial awareness and some programming skills. Before you fly a drone though, there's information you need to know.

## Rules and Regulations

**Register your drone**: Any drone that weighs over 8.8 ounces or 250 grams must be registered with the FAA. Unless your drone is very small, it probably weighs over 8.8 ounces. The registration fee is $5 and the FAA identification number must be displayed on the outside of your drone. You can register your drone at the FAA's DroneZone website https://faadronezone.faa.gov/. Beginning on September 16, 2023, all drones must have a remote ID. Manufacturers must start producing drones with remote ID by mid-September, 2022. There are already after-market adaptations available.

**Recreational vs non-recreational and the education exemption:** The purpose of a drone flight determines which set of rules you have to follow. The FAA distinguishes between recreational and non-recreational use. Recreational use is all about the fun of flying a drone and no other purpose. Non-recreational use of a drone includes everything else and requires that you obtain a Remote Pilot Certification. You'll be flying your drone under the the FAA's Small UAS Rule (Part 107). You have to complete an initial test and recurring training every 24 months. The recurring training is now online!

An FAA exemption for educational and research purposes was enacted in 2021. The drone use must be part of a higher education institution's curricula or research. There must be an operational approval process and you still have to follow the airspace and manned aircraft rules. Keep an eye out for updates (https://uscode.house.gov/view.xhtml?req=granuleid:USC-prelim-title49-section44809&num=0&edition=prelim); This

REDINA FINCH (rl-finch@wiu.edu), editor in chief of *In the Trenches*, is a professor in the Department of Earth, Atmospheric and GI-Sciences at Western Illinois University, Macomb, IL.

is a new exemption in 2021 and may change. I have not seen any "regulations, procedures and standards" established yet.

If you think you might ever use the drone for something unrelated to education and research, operate under Part 107 and get your drone pilot certification.

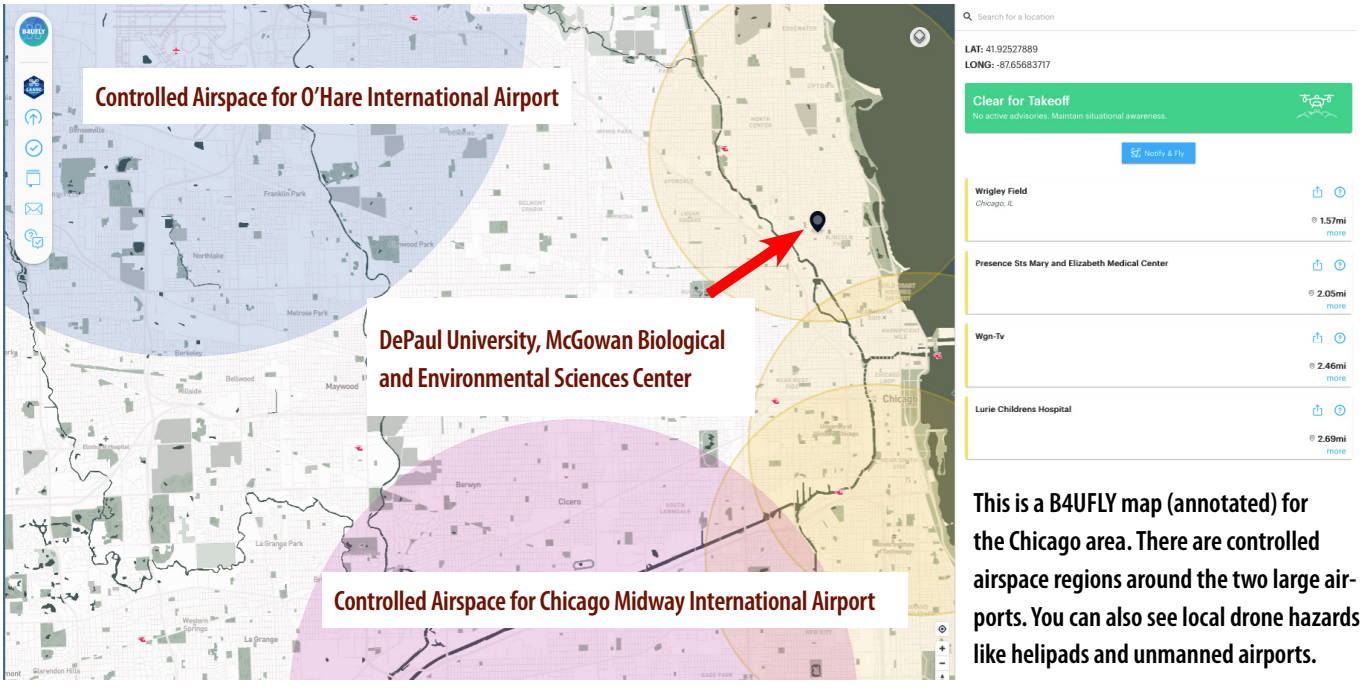
**Part 107**: In order top operate under Part 107 you have to pass a comprehensive exam. This test covers aeronautical safety, FAA regulations, understanding airspace, drone safety, etc. There are study guides available from the FAA and your study guide usually comes with sample tests and the book of maps that you will have during the test. You can buy a copy or download it for free. Be sure to get the study guide for the year you intend to take the test. Regulations get changed quite often. If you look on Amazon.com you will find LOTS of Part 107 study guides. I stuck to the resources from the faa.gov website and the Remote Pilot Test Prep book put out by ASA (Aviation Supplies and Academics). Updates took effect on December 2, 2021.

To prepare for the Part 107 test, I attended an online drone training course hosted by my university. I also completed a drone training course on Udemy from the PilotInstitute. This is not an advertisement; it's just the one I used. You need a 70% to pass.

**General rules**: First and foremost, don't interfere with manned aircraft. They always have the right of way! Your drone must be visible to you or a visual observer standing next to you at all times. Always fly below 400 feet and with a visibility of at least 3 miles. You also can't fly over people unless they are involved in your project and know there will be a drone overhead. You can only fly in Class G (uncontrolled) airspace unless you have prior authorization from the FAA through LAANC. If you are flying recreationally (or for education purposes), you must have proof that you passed the TRUST (The Recreational UAS Safety Test.) If you are flying under Part 107, you should have your license with you. Much more information from the FAA about drone regulations can be found here: https://www.faa.gov/uas/.

## Pre-flight Checklist

**Can you fly?** The first place I look to determine if I can fly is an app called B4UFLY. This app is available for both Android and IOS. It's also available online at https://b4ufly.aloft.ai/. Click on the map to place a marker where you will be flying and the app lets you know if you are in restricted airspace. It will also indicate if there are any other restrictions for the area, like the president of the United States flying overhead or military training operations. There is also a link to LAANC where you can request permission to fly in restricted airspace. I've heard that the turnaround time for LAANC is pretty quick. Pretty quick could still be a week, so request permission early. Airspace can be very complicated.




**This is a B4UFLY map (annotated) for the Chicago area. There are controlled airspace regions around the two large airports. You can also see local drone hazards like helipads and unmanned airports.**

**Is it safe for your drone to fly?** The second place I look to determine if I can fly is OK to Fly at https://oktofly.com/. Put in your coordinates and click on the date you want to fly. The colors indicate how safe it is for your drone to fly. For each date and time, you can see temperature, visibility, precipitation probability, winds speed, gusts, UV Index, the number of pilots who plan to be in the area, Kp index and the number of satellites available for GPS. You'll need a minimum of 11 satellites for stable GPS.

**Visibility** must be at least 3 miles according to FAA regulations. Even if the visibility is 3 miles at the ground, you can't fly unless the visibility is at least 3 miles at the altitude you are flying. This means you can never fly into a cloud or fog. This is probably safer too because you don't want to to encounter an airplane or risk the drone's electronics getting wet.

**Winds speed and gusts** will determine whether or not you will be able to control your drone. A rule of thumb for drones is that you can fly the drone up to two-thirds of the drone's maximum speed. For my drone, the maximum speed is 40 mph (in a lab.) Two-thirds of this is 26 mph. Just because you can fly the drone doesn't necessarily mean you will be able to control it. Also, be sure to consider the wind speed and gusts. Keep in mind that wind speed usually increases with height. For beginners, 10-15 mph is recommended. OK to Fly does a great job of indicating where the winds are strong.

**Temperature** controls battery efficiency. Very cold or very warm temperatures cause the battery to decline faster. When it's colder, the chemistry in your battery doesn't work as efficiently. When it's hot your drone has to work harder because the air is thinner. Extreme heat (normal battery heating + very hot day) may cause the battery to expand—sometimes even explode.

**Kp Index** is an indicator of the stability of Earth's magnetic field. Strong solar activity can cause the magnetic field to fluctuate. Drones rely on the magnetic field for navigation. A KP-index of 4 or less is recommended for safe done flight.

**Should you fly?** Always inspect your drone before takeoff. If you notice cracks in the drone housing, cracked or warped propellers, or anything else than can destabilize the drone then you should not fly. Make sure your battery or batteries are full. I make it a point to carry extra batteries and propellers. Another general rule is to think about landing your drone when the battery is at 50%; definitely land your drone when the battery gets to 20%. Drone batteries drain quickly.


**The Ok to Fly website gives a daily overview of conditions that affect your drone, as well as hourly information that is more specific. Red means no flying today!**

The final thing I do before I fly is check out my field of view. Scan the sky to make sure there are no other aircraft or powerlines. Cables are very hard to see, but they can do a lot of damage to a drone. Look for anything moving in the sky. Yep, birds can attack your drone! To do an effective scan of your field of view, you should look at each sector of the sky for 2-3 seconds. The eye is really good at "not" seeing things unless you specifically look for them.

## My Journey to Using Drones

I teach a Weather Instruments class where students build their own weather instruments using Arduino. Arduino is a programmable electronics platform that allows students to build their own weather instruments (and so much more!). Additional information can be found here: https://www.arduino.cc/en/Guide/Introduction

Several years ago I borrowed a dropsonde (it's like a weather balloon but designed to fall with a

**A dropsonde is an instrument that measures atmospheric variables (temperature, pressure, etc.) as it falls through the air. The student project involved lowering the dropsonde down the side of a building to measure temperature, dew point temperature, and pressure variations with height. [Photos: Redina Finch]**

parachute inside storms and hurricanes) from the Research Applications Lab at the National Center for Atmospheric Research to show to my class. The students had to do a field project and a couple of them wanted to use the dropsonde to measure the temperature, humidity, and pressure variations along the sunny and shady sides of a campus building. The project was a huge success and the students learned a lot about site selection and thinking on their feet.

This started me thinking about ways we could include a vertical component in more of our field projects. The next year we used tethered helium balloons to launch our instruments. The balloon was tethered because I don't like to throw away my toys. This was good, but the weight of the string didn't allow the balloon to rise very far and any wind affected balloon height.

I wanted a more stable platform. The university owns several DJI drones through our GIS Center, but I wanted something more robust for my Weather Instruments class. I applied for a grant through a local opportunity called the John Blauvelt Geography Fund and purchased a Swellpro Splash Drone 3+ (The fishing drone! See page 4.) I chose a 3-axis gimbal 4K camera and a 2-axis gimbal night vision camera to accompany the drone. I also went with the payload release mechanism so we could drop our instruments with a parachute.

**Weather Instruments students getting ready to launch their field project instruments via tethered balloon. [Photo: Redina Finch]**

All drones produce heat, so the first thing the class did was determine how far away the instrument needed to be from the drone to get reliable readings. The answer here depends on the weather conditions, but we did figure out how to keep the drone balanced in flight with a payload hanging under it. The Swellpro drone can hold a payload of up to 2 pounds (including cameras and any instruments.) Two pounds is a lot of electronics, but not a lot of batteries. The new Swellpro drones can carry up to 4.5 pounds!

Before we went out for field projects, the class learned about drone safety similar to the material covered above. I had students brainstorm things you might not think about while you're flying a drone, like powerlines and birds. I also emphasized the importance of teamwork and situational awareness. The pilot will be focused on the drone, while the other group members are aware of the surroundings.

One of the other nice things about this drone is that it's waterproof and floats. We conducted two different field projects over lakes this year. One group looked at how the temperature and moisture profile over a lake varied with time of the day and weather. Another group did a similar project but compared a large-ish lake versus a smaller one. (No, the drone did not take a swim.)

Do you have questions about how to get started with drones or Ardiuno? Email me: RL-Finch@wiu.edu.

# (EVEN) MORE TO KNOW BEFORE YOU GO

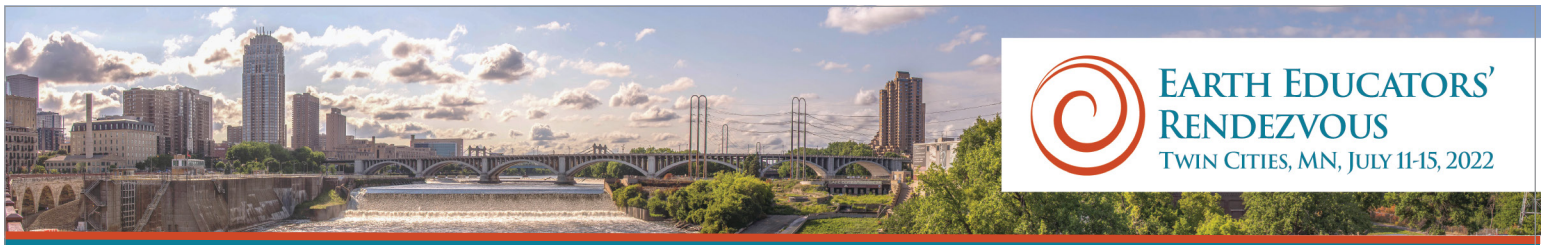
It's tempting—oh so tempting—to use drone technology to study natural phenomena or to capture the beauty of national parks and preserves. There are rules about such things, however, just as there rules are about being certified competent to fly an unmanned aircraft. For very good reason. In recent years drones have crashed into geysers in Yellowstone National Park, attempted to land on the features of Mount Rushmore National Memorial, been lost over the edge of the Grand Canyon, and been stopped from flying in prohibited airspace over the Mall in Washington DC. They have not only intruded on natural habitats, they have been used deliberately to harass wildlife.

**NOAA researchers launch a drone being used to study Steller sea lions. [Photo: screen shot from NOAA video at https://www.youtube.com/watch?v=oiL8tDCqzy4&t=2s]**

The National Park Service uses unmanned aircraft—when appropriate and approved by the director of the region in which the park is located—for things such as search and rescue operations, fire operations, and scientific studies. But, for the reasons noted above, most national parks greatly restrict or prohibit altogether the recreational operation of unmanned aircraft on the lands and waters they administer, especially if drone usage has the potential of disturbing wildlife nesting, breeding, or other activities. Animals can become so anxious when drones fly nearby that they abandon their young to attack or flee, exposing eggs or young animals to predators in the process. Violation of the ban is a misdemeanor with the maximum penalty of six months in jail and a $5,000 fine. See https://www.nps.gov/articles/unmanned-aircraft-in-the-national-parks.htm for more information.

Consult with the appropriate authorities, therefore, while designing your research. If your project will be directed at marine mammals or sea turtles at an altitude below 400 feet, for example, you'll need a permit from the National Oceanic and Atmospheric Administration (https://www.fisheries.noaa.gov/national/marine-life-viewing-guidelines/permitting-scientific-research-using-small-unmanned).

Restrictions also apply to the use of drones during natural disasters such as floods or earthquakes. Although they can be useful for scientific studies and in determining emergency response needs, they can pose a distinct danger to first responders, as a public service announcement at the website of the National Interagency Fire Center (https://www.nifc.gov/drones/) notes. In addition to inhibiting official aerial supervision, drones can pose great risks to firefighters: air tanker retardant and water drops and smokejumper paracargo drops occur between ground level and 200 feet above ground level, the same altitude that many drones fly. Often, due to safety concerns, firefighting aircraft must land when drones are spotted near a wildfire.



# Earth Educators' Rendezvous

Twin Cities, MN, July 11-15, 2022

## University Of Minnesota, Twin Cities, July 11-15, 2022

The eighth annual Earth Educators' Rendezvous is designed to serve all who are interested in improving K-12, undergraduate, and graduate teaching about Earth. Learn about new teaching approaches, opportunities to get involved in research programs, and preparing for an academic career. You can also present and discuss your findings in the contributed program.

Events include interactive workshops, oral and poster sessions, plenary talks, teaching demonstrations, and working groups. Help build a collective capacity to use and conduct education research, and increase the overall impact on Earth education.

**View the program, register, and get updates:**

http://serc.carleton.edu/earth_rendezvous/2022

**Early Registration Deadline: May 3**

**Review Camp Applications Due: May 3**

**Deadlines:** Abstract: March 1, 2022 • Late Poster/Share-a-Thon: May 17, 2022