Nature Conservation Agency of Iceland

John Bass
3000 Boulevard de l'Université
Université de Sherbrooke - 3IT
J1K 0A5 Sherbrooke
Canada

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Efni: Umsókn um rannsóknarleyfi - Université de Sherbrooke - John Bass - Skeiðarárjökull, Skaftafellsjökull, Svínafellsjökull, Virkisjökull, Kvíárjökull, Fjallsjökull, Fjallsárlón, Breiðamerkurjökull, Jökulsárlón, Skálafellsjökull, Heinabergsjökull, Fláajökull, Hoffellsjökull – 05.05.2025 – 09.05.2025

The Nature Conservation Agency of Iceland has received an application from John Bass, dated 28.03.2025, to conduct research within Vatnajökull National Park.

Description of the project:

Project name:

DART UAV Iceberg Landing

Date, timeline and duration of the project:

05.05.2025 – 09.05.2025, we expect to conduct up to twenty 10-minute flights during this period.

Location inside Vatnajökull National Park:

Skeiðarárjökull, Skaftafellsjökull, Svínafellsjökull, Virkisjökull, Kvíárjökull, Fjallsjökull, Fjallsárlón, Breiðamerkurjökull, Jökulsárlón, Skálafellsjökull, Heinabergsjökull, Fláajökull, Hoffellsjökull. These glaciers were chosen for their easily accessible lakes in which icebergs form. Specific trial locations will depend on iceberg presence at our arrival.

Description of the project, purpose and execution:

The project consists of demonstrating the capabilities of a novel UAV landing gear developed by the Createk Design Lab (Canada). Quadcopters currently have very limited landing capabilities and are restricted to land at slow speeds on straight surfaces, which limit their usage in real harsh outdoor conditions. Having the ability to land rapidly on steep icy or rocky slopes could be very beneficial to many different groups of people or institutions. For example, drones positioned on large icebergs in the Labrador Sea could be used as remote sensors to monitor the icebergs trajectories and prevent collisions with offshore oil rigs, which would have

detrimental effects on the local marine ecosystem. Drones with the ability to land on steep ice or snow could also be useful to scientific groups during field work to detect and mitigate avalanche risk, by landing at a predetermined “at-risk” location for longer-duration sampling without using energy to hover. Finally, such a landing technology would benefit researchers who need to acquire ice samples from icebergs and glaciers without risking people’s lives, and without limiting sampling options to only horizontal iceberg surfaces.

The Vatnajökull National Park is the ideal location to demonstrate the potential of our novel landing gear to the scientific community and bolster new innovative drone usage in real-world outdoor contexts. Our landing technology consists of using a custom specialized landing gear with spikes on the feet to handle high-speed impacts while automatically reversing the thrust direction at impact. Preliminary trials indicate that our landing technology can land on ice surfaces as steep as 60 degrees. This technology has been tested on more than 80 different missions at our home facility, in various contexts: Landing on non-slippery surfaces (wood, rooftop shingles) at up to 60°, landing on moving vehicles at up to 110 km/h, landing on a moving boat at up 20 km/h.

The operational crew for the entire field trials consists of three members:

- Pilot 1 (Isaac Tunney): Main pilot for the DART UAV, our 2.7 kg drone that will demonstrate landing on icebergs.
- Pilot 2 (John Bass): Main pilot for the DJI Mavic drone. This drone acts as a visual aid to help correctly position the DART UAV prior to landing on the iceberg.
- Ground Control Station (GCS) observer: Person responsible to monitor the DART UAV’s health, battery life and mission status on the GCS, while also monitoring for approaching birds and bystanders. Report to pilot 1 in case of warning/problem. Both pilots are licensed pilots in Canada and are currently registering with the Iceland Transport Authority. The GCS will be setup on or near the shore of a glacier lake, far from potential tourist areas. The GCS has a small footprint of about 1 square meter and is comprised of two tripods, a foldable bench and a laptop. Everything will fit in two pelican cases and a few backpacks. The tripods hold up a GPS antenna, as well as the digital transmission system for communication between the drone and the GCS.

The mission profile is as follows: - Pilot 2: Manually fly the DJI Mavic to survey the nearby icebergs (withing 400 m from the shore) and find an appropriate iceberg to land on. Max flight altitude of 60 m. - Pilot 1: Manually fly the DART UAV at a relatively low altitude (under 40 m) to the selected iceberg. - Pilot 1: Hover the DART over the iceberg above the preselected landing site. Adjust the exact hover position based on visual feed from onboard camera and indications from pilot 2. - GCS Observer: Confirm to pilot 1 that the ice slope is equal to or under 45° (data from sensors, displayed on GCS software). - Pilot 1: Activate the preprogrammed automatic landing sequence, which consists of descending vertically at 1-2 m/sand reversing the motors’ spin direction upon impact detection to create thrust towards the ice surface. The passive

landing gear will dampen the drone's impact, and the spikes will pierce into the ice to prevent slipping. - While landed on the iceberg (up to 30 minutes), the drone will record iceberg motion data. - Pilot #1: Manually take-off the DART UAV, fly it back to shore and land. -Pilot #2: Fly the DJI Mavic back to shore and land. Throughout the tests, a Visual Line of Sight (VLOS) will be maintained with both drones. Additionally, an onboard camera will also be used by pilot 1 to help align the drone in a suitable landing orientation. We want to perform this mission at most 20 times during our 4 days of trials.

Early May was specifically chosen for the field trials to avoid the summer tourism. We understand that we must only fly in areas far from other tourists and hikers. Finally, even though the UAV is designed to land on ice surface inclinations of up to 60°, the trials in Iceland will be limited to the 0-45° range to provide a sufficient margin of safety. In the event where the DART UAV slides off the iceberg and falls in the water, it is designed to have enough buoyancy to float. The DJI Mavic drone, equipped with a fishing attachment, will be manually flown above the floating DART UAV, and it will drop a hook attached to a fishing line. The Mavic, now disconnected from the fishing line, will be flown back to shore, while the pilot of the DART will reel in the DART UAV with a fishing reel. If the drone is unretrievable, we will alert park employees.

At Jökulsárlón: We will ask park employee for known bird nesting areas, in order to avoid them. If nesting areas are visible, we will use a rangefinding binocular to setup our base station at least 150 meters (or any distance told by park employees) away from the birds, while making sure that our flight path does not come within 150 meters of them. We can walk up to 6 km with all our equipment to find a suitable location on the shore near icebergs, but far from birds and other tourists. Boat tours run from 9 AM to 6 PM. In early May, there is daylight between 5 AM and 10 PM. To avoid flying over boat tours, we can prioritize flying between 5 to 9 AM and 6 to 10 PM, unless we are told that these periods are especially important for bird protection. In case we fly between 9 AM to 6 AM, we will also ask park employees for their planned boat routes, to guide our selection of area to fly in. Jökulsárlón's landscape, size and abundance of icebergs make it an ideal place to conduct our research trials. However, if we are not granted to fly at Jökulsárlón, we still wish to obtain a research permit for the other proposed locations. As at Jökulsárlón, if there are boats tours on other glacier lakes in Vatnajökull National Park, we will coordinate our flights with park employees and/or boat tour operators and fly back to shore if boats approach us. If there are visible bird nesting areas around other glacier lakes, we will maintain a minimum distance of 150 meters from them. Of course, rules and guidelines from the Iceland Transport Authority and the Environment Agency of Iceland will be respected, such as staying on authorized paths/roads as well as wearing marked clothing to identify the pilots.

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Description of methods for sample taking, if part of the research:
Other than photos and videos from the drones' on-board camera, no physical samples will be taken.

Other information that the applicant wants to submit:
We would like to emphasize that multiple glacier lake locations of the Vatnajökull National Park were chosen during the five-day field trial period to be able to decide on the exact glacier lake to fly at based on icebergs availability and to be able to adapt to the weather, tourist activity, bird presence, and other external factors. In the location form, we have listed all 12 potential locations deemed suitable for our trials. Lastly, while the total flight duration will be kept to a minimum, abroad time window (5 AM to 10 PM) was specified on the form to provide flexibility in responding to weather conditions and tourist/hiker presence.

Conditions:
The Nature Conservation Agency of Iceland hereby grants John Bass permission on its behalf to conduct research within Vatnajökull National Park as described above on 05.05.2025 – 09.05.2025 on the following conditions:

- Keep this letter with you on site during the project. The permit conditions should be introduced to the staff of the project before work begins.
- The applicant shall inform rangers in the area about their arrival and departure. This is to be done 24 hours before entering the area and again before leaving it. The best way to do this is to "reply-all" to the e-mail that this permit was sent with.
- If the project dates or description changes the Nature Conservation Agency shall be notified as soon as possible. However, the permit holder may use the permit for up to two days before or after the date given, should weather or other conditions require, without notifying the park.
- When it is necessary to go off-path, extra care must be taken not to cause damage to terrain, including vegetation, soil and geological formation. All traces of activity must be removed afterwards.
- All traces of the work must be removed carefully from the site by the end of the work/project.
- If any complications occur during the project, please contact the ranger or the Nature Conservation Agency of Iceland, tel. +354 556 6800, or the ranger based at Jökulsárlón, tel. +354 842 4355.
- This permit is only valid for research purposes. It does not include a permit to utilize the samples for commercial purposes. The samples cannot be signed over to third party for commercial use.

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- All participants in the project must wear high-visibility clothing during field work, labelled with the identity of the researcher or the research institute.

Conditions for drone flights for research

- The applicant should be conscious of other guests on the sites and make sure that the drone flight causes as little disturbance as possible to other visitors.
- An unmanned aircraft should never be flown in close proximity to people. Please take precaution not to disturb people's experience, their safety or personal privacy nor the general peace of the protected areas being filmed.
- According to Icelandic law it is forbidden to fly close to cliffs where birds nest. An unmanned aircraft should never be flown near animals or birds, neither in nesting areas nor during nesting season or any other seasonal time when animals or bird habitats are considered vulnerable.
- Flight time should be kept to a minimum and flight should be avoided during the area's busiest times of the day.
- If the use of unmanned aircraft causes disturbance to wildlife in the area, its use should be ceased at once.
- The conductor of the unmanned aircraft is responsible for the aircraft within the protected area. This includes taking responsibility of any possible risk of harm to people, fauna and nature and leaving no permanent marks on the site in question. Should the aircraft crash, all components from it must be collected and removed from the area.
- For safety reasons, the pilot of an unmanned aerial vehicle must wear marked clothing so that the person can be identified.
- If falcons or eagles are seen in the area, it is not allowed to fly the drone there.

Site-specific conditions:

- **Breiðamerkurjökull and Jökulsárlón**: Boat tours are operated on Jökulsárlón between 09:00 and 18:00. **Due to bird protection, drone flying is not allowed for recreational drone users from April 15th to July 15th.** An exception will be made for this research project, however, you must check-in with the rangers at Jökulsárlón the day before first day of drone flights. They will direct you to where you may fly without disturbing nesting birds.
- **Skeiðarárjökull, Skálafellsjökull, Heinabergsjökull and Heinabergslón**: no site-specific conditions.
- **Skaftafellsjökull**: Drone flying is generally prohibited in Skaftafell. An exception is made for flying drones in front of Skaftafellsjökull, but only early in the morning or in the evening, before 09:00 or after 18:00.

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- **Svínafellsjökull, Kvíárjökull, Fláajökull, Hoffellsjökull:** It should be noted that while the glacier and lagoon are within the National Park, the surrounding land is not. Therefore, a permit may be required from the landowner.
- **Virkisjökull:** this outlet glacier is used for summer glacier hikes by many glacier guides. There is considerable traffic and presence of tour groups in this area.
- **Fjallsjökull and Fjallsárlón:** Boat tours are operated on Fjallsárlón between 09:00 and 18:00. It should also be noted that while the glacier and most of the lagoon are within the National Park, the land on the west side of the lagoon is not. Therefore, a permit may be required from the landowner.

Best regards,

Charli E. J. Brzeski
Assistant Park Manager
Vatnajökull National Park

VATNAJÖKULSÞJÓÐGARÐUR
NATIONAL PARK
Kt. 441007-0940