



Project Report Östersund, September 2022

Introduction

The drone tests in this report are carried out within the Green Flyway project and were carried out during the month of September 2022. The preparatory work was completed during the period June to August 2022. These preparations include:

- Restriction area application and cross-border authorization
- Coordination with entities
- Meetings with entities and the Swedish Transport Agency
- Coordination with Swedish Aviation Authority
- Coordination with Swedavia
- Food transportation preparations
- Blood transportation preparations
- Medicine transportation preparations

The drone tests included:

- Food transportation for the elderly care, between Lit and Munkflohögen or Österåsen.
- Blood transportation between Lit's healthcare center and Ås*.
- Medicine transportation between Ås and Lit's healthcare center*.
- Drone flights from Åre Östersund Airport to Ås*.

*Landing location close to Östersund had to be adjusted. This is covered later in the report.



Europeiska regionala utvecklingsfonden



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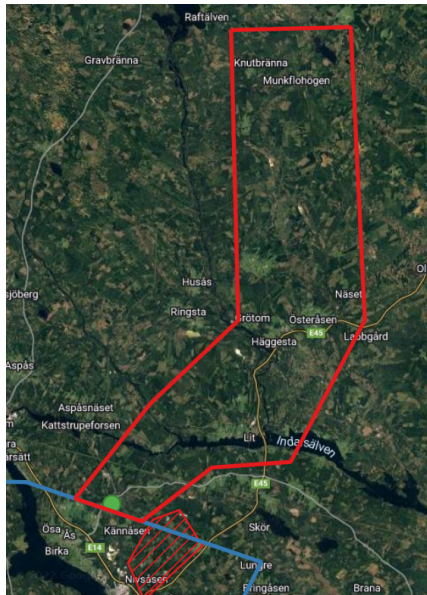
Objective

Transportation of blood and medicine between hospitals and healthcare centers is a time consuming and non environmental process as conventional cars/vans are utilized today. This transportation follows a predetermined schedule and has no room for flexibility. Drone transportation gives the possibility of sending urgent blood samples on demand and sending medication when the healthcare centers need it. Five flights, turn and return were performed and this is a route that the Region has identified as possible where drones could replace road transport.

Food transportation to elderly persons is today transported in cars. Using drones could reduce both transportation costs and will reduce carbon emissions. Today the food is transported by road. Tre flights delivering food were made, two to Munkflohögen and one to Österåsen.

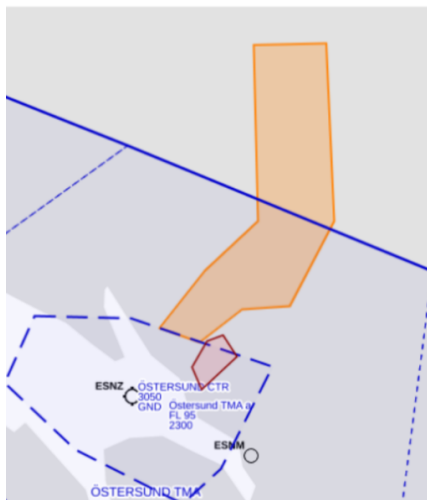
Flights to and from controlled airspace does not yet have an established procedure for BVLOS flights, and therefore it is of great interest to perform as many flights from Östersund CTR as possible. In the future cargo and freight could be transported through this route. This also included flying from an active and controlled commercial airport, Åre Östersund Airport. This flight was made one time turn and return.

Restriction area



To conduct BVLOS (Beyond Visual Line Of Sight) in Swedish airspace a segregated airspace must be established. The segregated airspace in this project is a Restriction Area. Within the controlled airspace, called CTR, segregated airspace is required as this area has other means of separation from other traffic. The CTR UAS-sectors enable segregated areas inside the CTR. This provides a separation from other VFR operators.

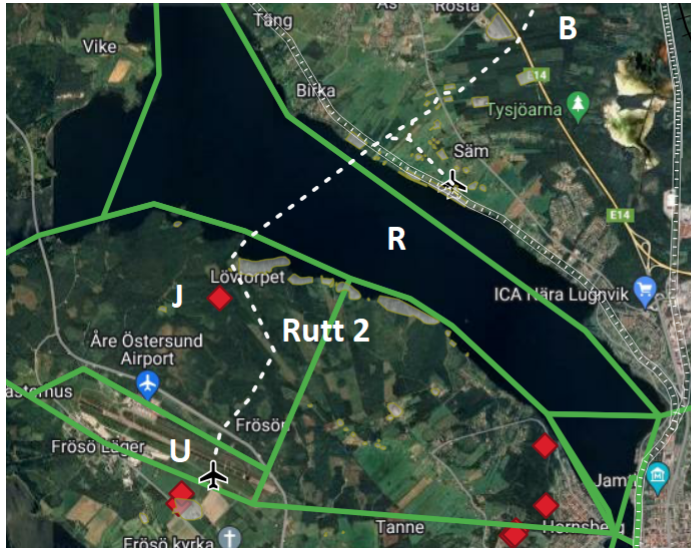
Seen on the left is the restriction area in red. The CTR is represented by the blue lines. As the two airspaces are adjacent to each other it allows BVLOS operations to cross into the other airspace.



The restriction area was constructed to not penetrate the TMA surrounding the CTR. Therefore the vertical boundary of the restriction area was limited to 2300ft. This allows for other traffic to pass over the restriction area inside the TMA.

The lateral boundaries were placed so as not to interfere with the permanent military airspace called R08 and any VFR entry points to the CTR.

CTR flight coordination



Within Östersund CTR there are UAS sectors to enhance UAV operations during the ATS opening hours. The sector can be used to fly VLOS.

Normally, one sector at a time is activated when operating inside the CTR. In this project, we had to occupy 4 sectors to perform the airport flight as the flight was only 7 minutes long. This required a special ATS procedure to be established together with the Swedish Aviation Authority (LFV).

The UAS procedure inside the CTR requires a week's notice and coordination the same day. The routes inside the CTR were named "Route 1" and "Route 2" to simplify ATS coordination. This coordination was made 30 min ahead of the flight and a takeoff and entry clearance was received over a phone call before launching the drone.



Entering the CTR was a bit more complicated as coordination 15 min prior to entering the CTR is too much time to get an ATC entering clearance. The risk of the CTR clearance would be canceled and actions would be needed from the pilot, meaning landing the drone. This is why an automatic loiter / holding pattern was programmed inside the end of the restriction area to the CTR. As the drone was loitering/holding in a circle we could wait until any IFR traffic had

left from the CTR and entered thereafter. The loiter was over a field where an immediate landing was available to perform if needed. The Swedish Aviation Authority considered the use of the transponder as positive as ATS could deactivate the UAS sectors during the flight.



Communication with commercial companies

Initially, the commercial operators opposed the restricted area because it blocked the free air outside the CTR. This is because once the restriction area is activated none of the commercial operators could pass through it. The majority of these operators fly under VFR, Visual Flight Rules, meaning that it might be impossible to pass over the restriction area during weather conditions below VMC, Visual Meteorological Conditions. VMC is a requirement for VFR operations. To solve this problem Aviant pointed out that activation of the restricted area would be fully adapted to their schedule. This was received positively by the companies. However, the Swedish Transportation Agency adapted a VMC condition to allow for passage above the restriction area, in the TMA at all times.

Transponder System

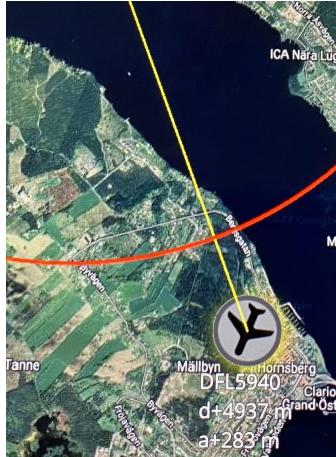
Operating the drone with a transponder Mode S would have great advantages for ATS and the Ambulance helicopter service. The ATS would be able to track and deactivate UAS sectors inside the CTR continuously as the flight was conducted. This would occupy less airspace inside the CTR for other operators. This is why the Aviation Authority advocated the usage of a transponder onboard the drone. Transponder would make the drone visible onboard the ambulance helicopter on the TCAS system, meaning that their pilots would have greater situational awareness when flying on alarm operations.

An authority called PTS, post and telecommunication board in Sweden, has not allowed for drones to be equipped with transponders onboard. When explaining the advantages to fly with a transponder onboard the drone, a temporary geographical limited permission could be granted but this solution was reached too late to be implemented in this project.

PTS together with aviation authorities had decided that drones in Sweden shall not be allowed to fly with a transponder. This is reasonable because transponder codes would become full. However, it is not probable that private persons would equip their drones with transponders due to high pricing and technical difficulties.



Automatic Dependant Surveillance System



ADS is a surveillance technology and form of electronic conspicuity in which an aircraft determines its position via satellite navigation or other sensors and periodically broadcasts it, enabling it to be tracked in the operating platform of the drone. As shown in the real example to the left, this raises awareness of other operators and actions will be taken in any proximity. This system does not detect traffic not equipped with a transponder or ADS-B out, meaning that some traffic might not be visible though ADS.

ADS could be a solution for a danger area where the ambulance could actually pass through the segregated airspace because they would see the position of the drone and the altitude.

Transport agency conditions

Based on previous experiences with restriction areas, this project got more conditions compared to before. These conditions were implemented by the transport agency to enhance airspace availability and to eliminate air ambulance delays.

VMC limitation - This was supposed to make it possible for other operators to pass over the restriction area at 2300ft inside the TMA. However when operations began Aviant realized that the VMC's are different at different altitudes. This means that if VMC was met between ground and 2300 ft AMSL this would not guarantee VMC above the restriction area. This VMC condition was later converted into limits: Cloud base of 2300 ft converted into AMSL and 5 km visibility.

Phones - The aviation agency required the Aviant pilot to have two individual phones with separated numbers during CTR operations. All ATS clearances were communicated through telephones.

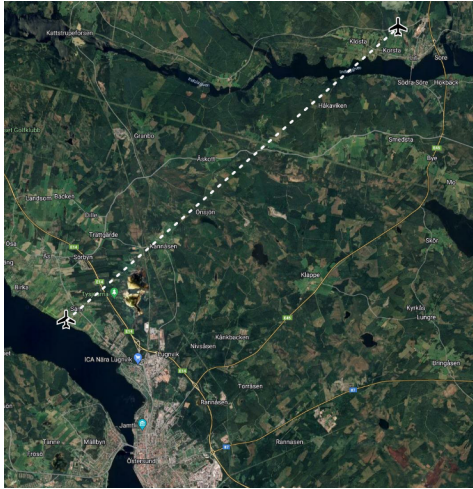
VHF radios - For all operations inside both the restricted area and CTR two handheld radios monitoring Sweden Control and Östersund Tower were required. This was to enable the drone pilot if any helicopter ambulance needed to pass through the restriction area.

Restriction area activation - The restriction area had to be activated to ATCC max. 60 minutes and min. 30 minutes before starting UAV operations.

Transponder - Aviation entities have addressed to the transport agency that usage of transponder onboard the drone would be an advantage. As there is no requirement to operate with a transponder according to EU regulation 2019/947 and that the other conditions provide enough safety.



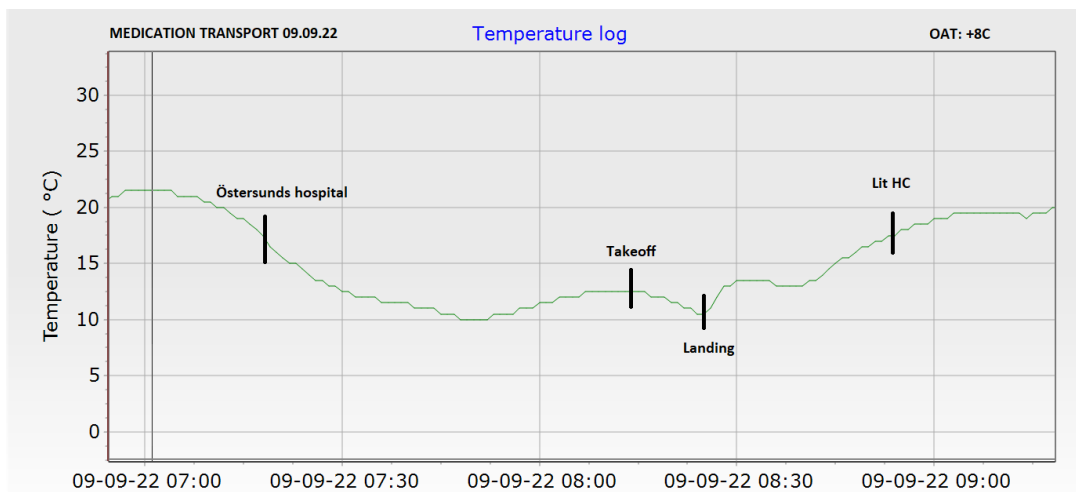
Medication and blood transport



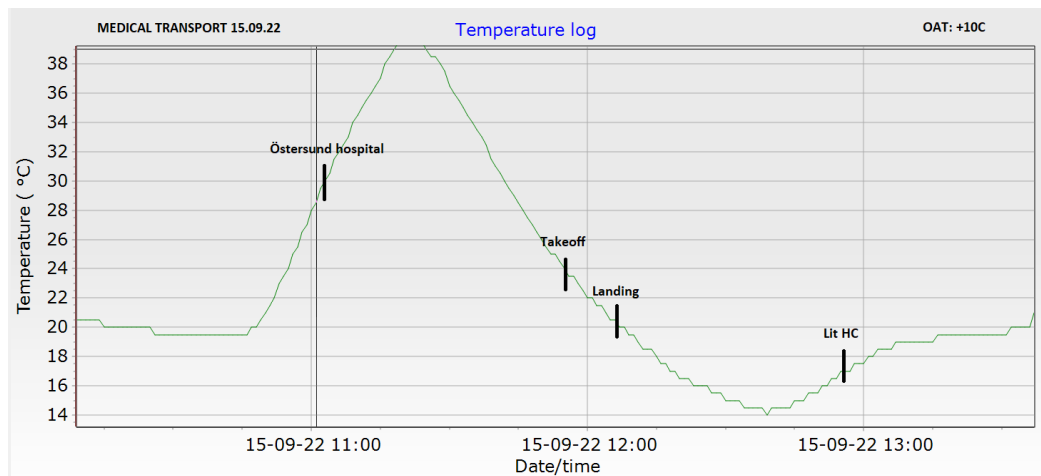
Blood and medication was transported between Ås and Lit. Initially this route was to be flown from Östersund Hospital or Jamtli brygga but coordination and the proximity of the ambulance operation was not considered safe without transponder usage by Aviant.

During the flights the air temperature was measured both for blood and medicine during the transport from the Hospital to the healthcare center in Lit. Below are all the temperature graphs for the blood and medication transport.

Medication transport 09.09.22

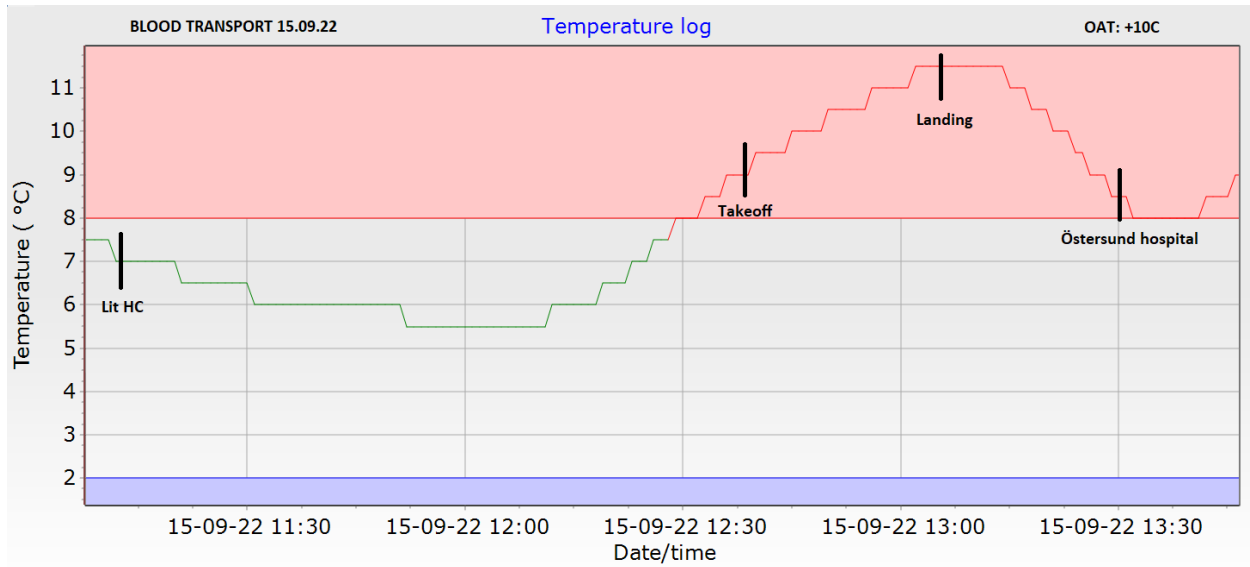


Medication transport 15.09.22

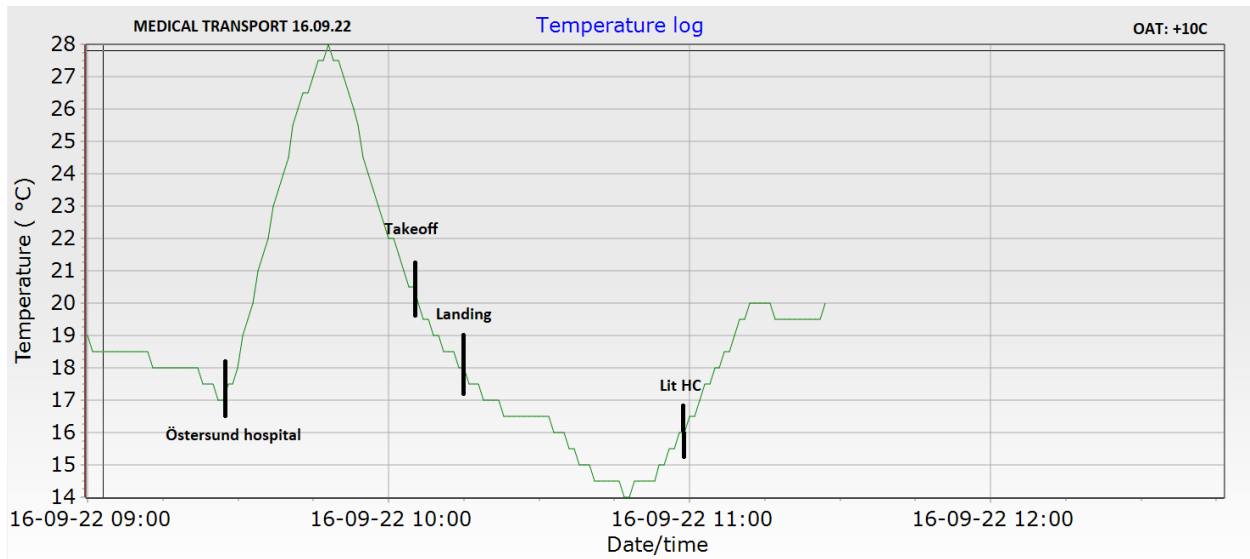




Blood transport 15.09.22

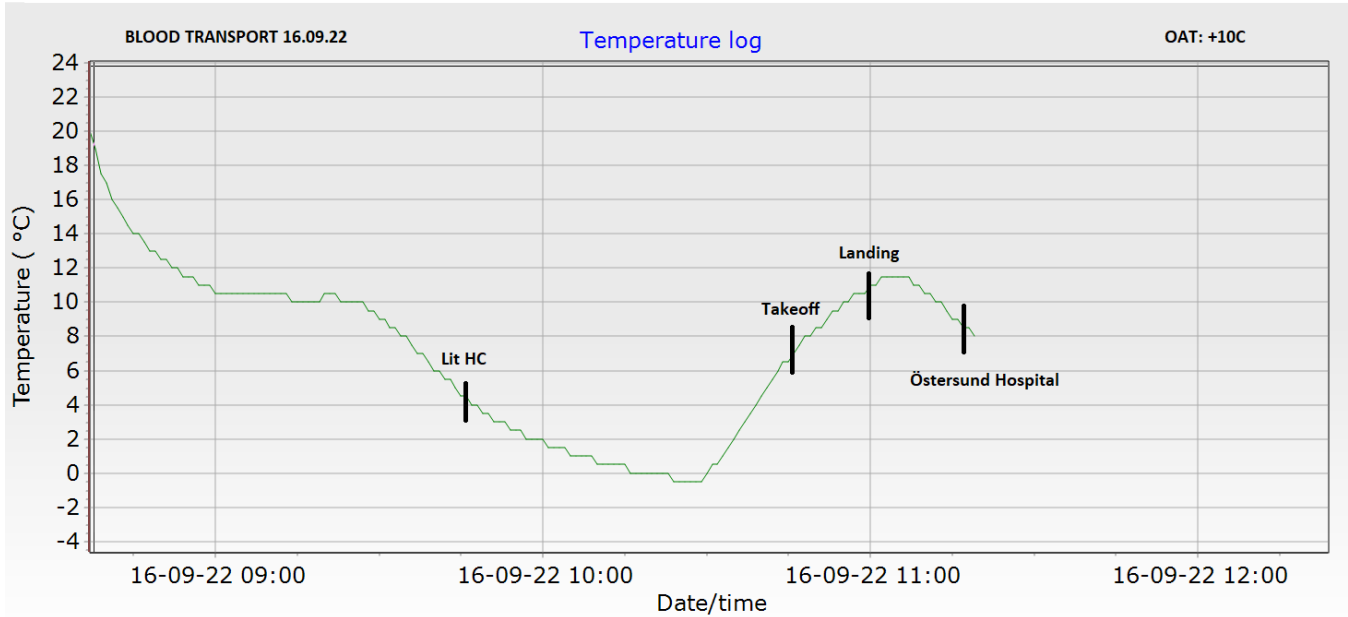


Medication transport 16.09.22

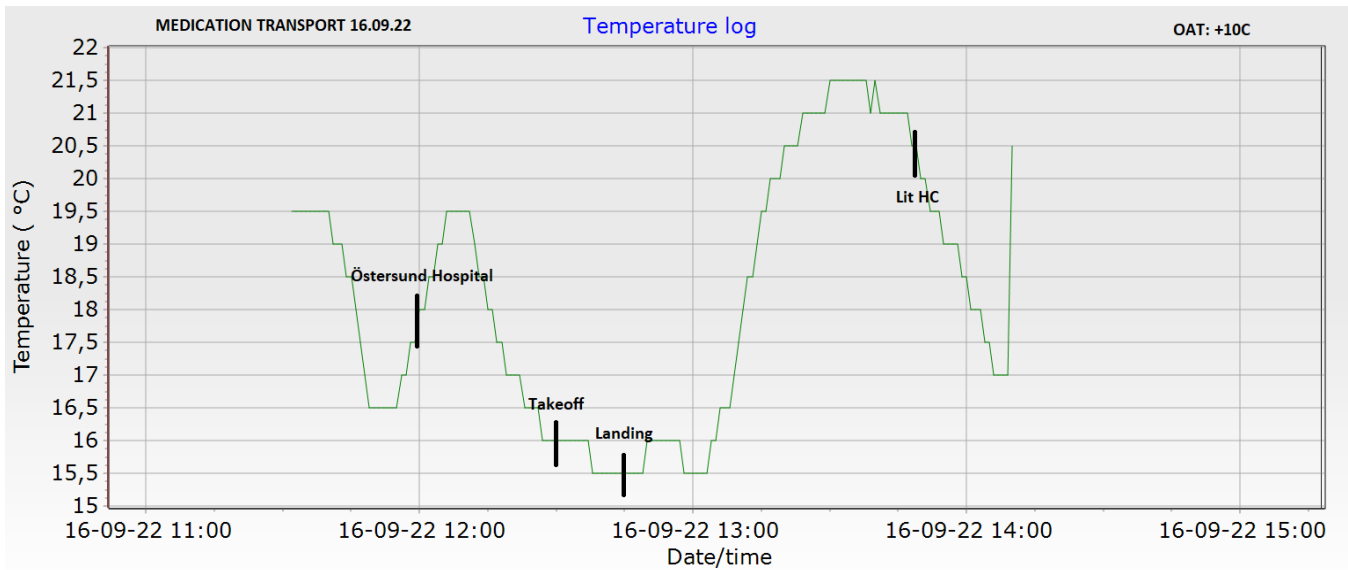




Blood transport 16.09.22

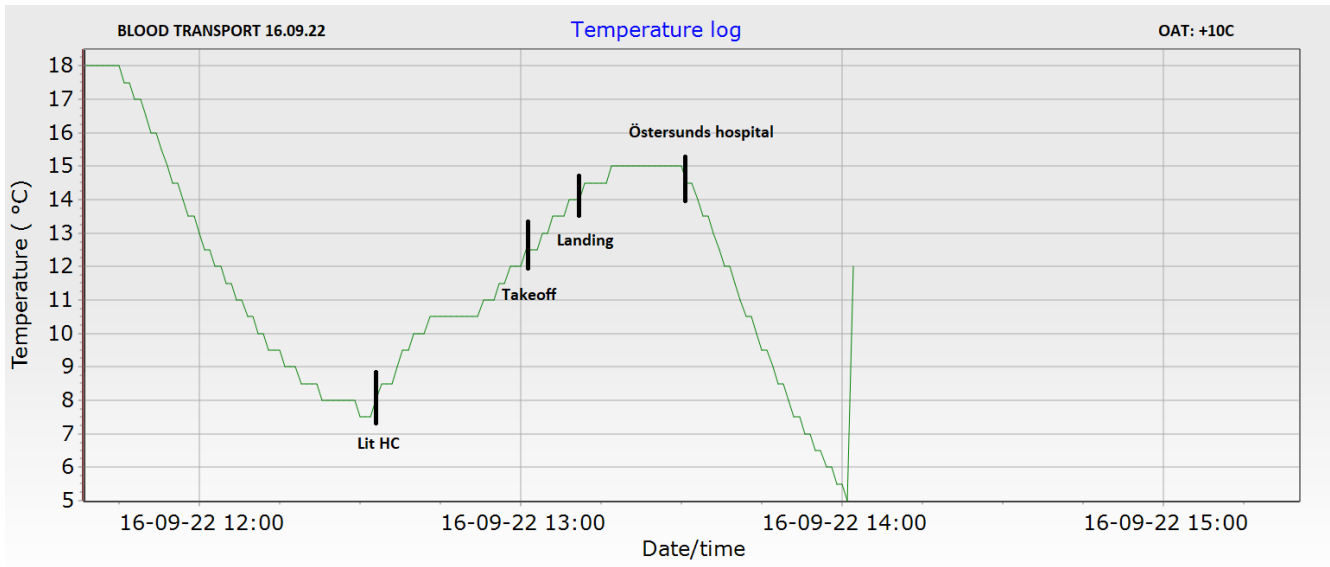


Medication transport 16.09.22

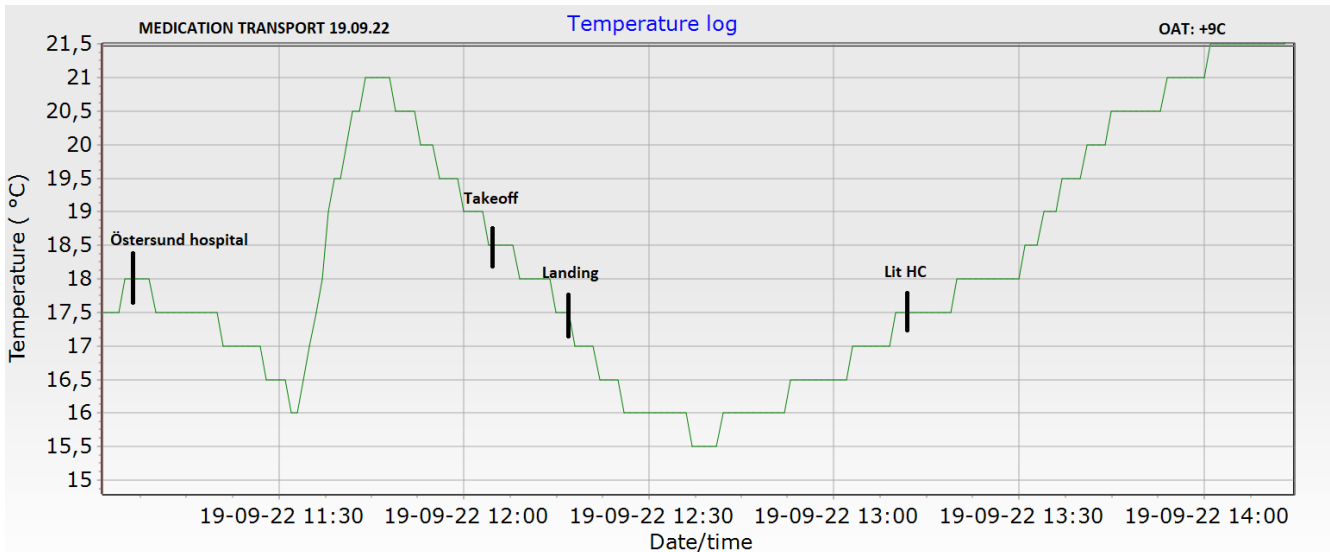




Blood transport 16.09.22

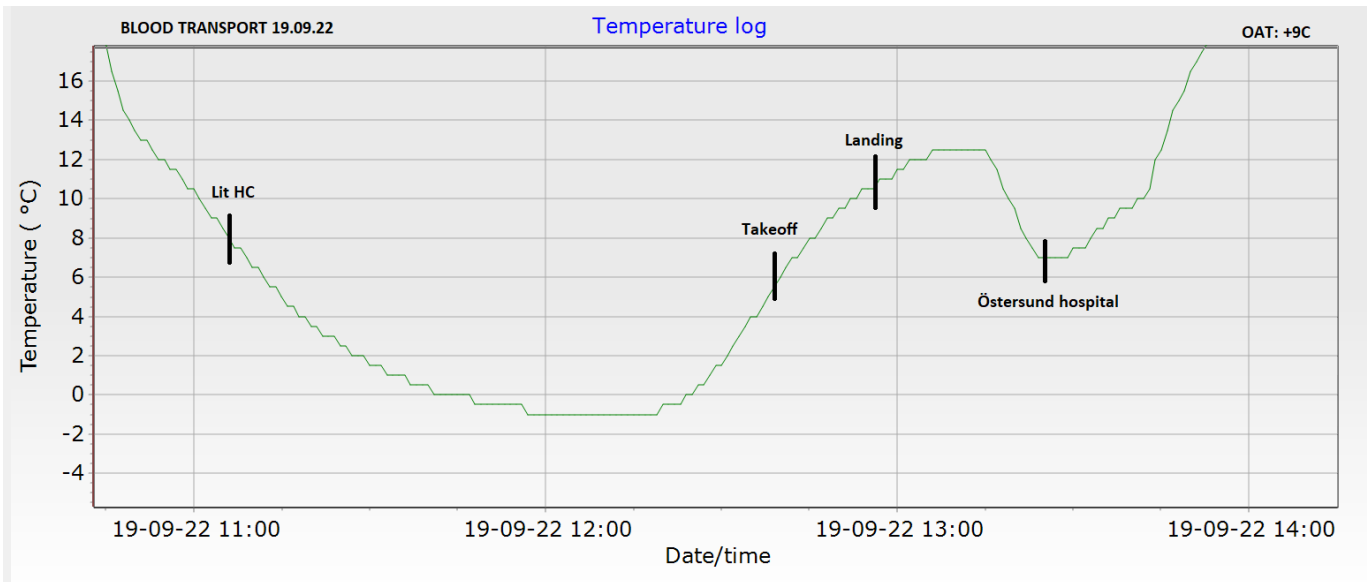


Medication transport 19.09.22



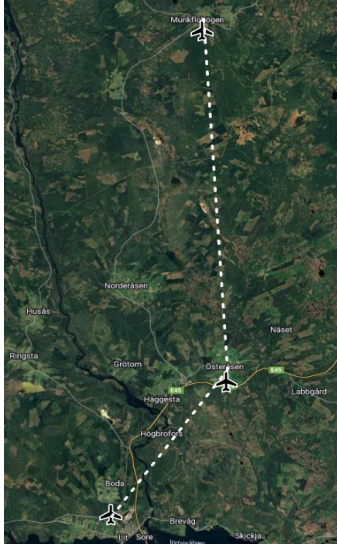


Blood transport 19.09.22



Temperatures are measured inside the transportation box and the temperatures vary. Actual blood is transported in a test tube and in addition a transportation tube. Blood will most likely not be affected adversely during short transport times. Blood should be transported in a cold environment while solid medications, depending on the type, shall be transported in room temperature. For future drone transportation of both blood and medicine the boxes can be further modified to keep a more even temperature at the desired temperature.

Food transport

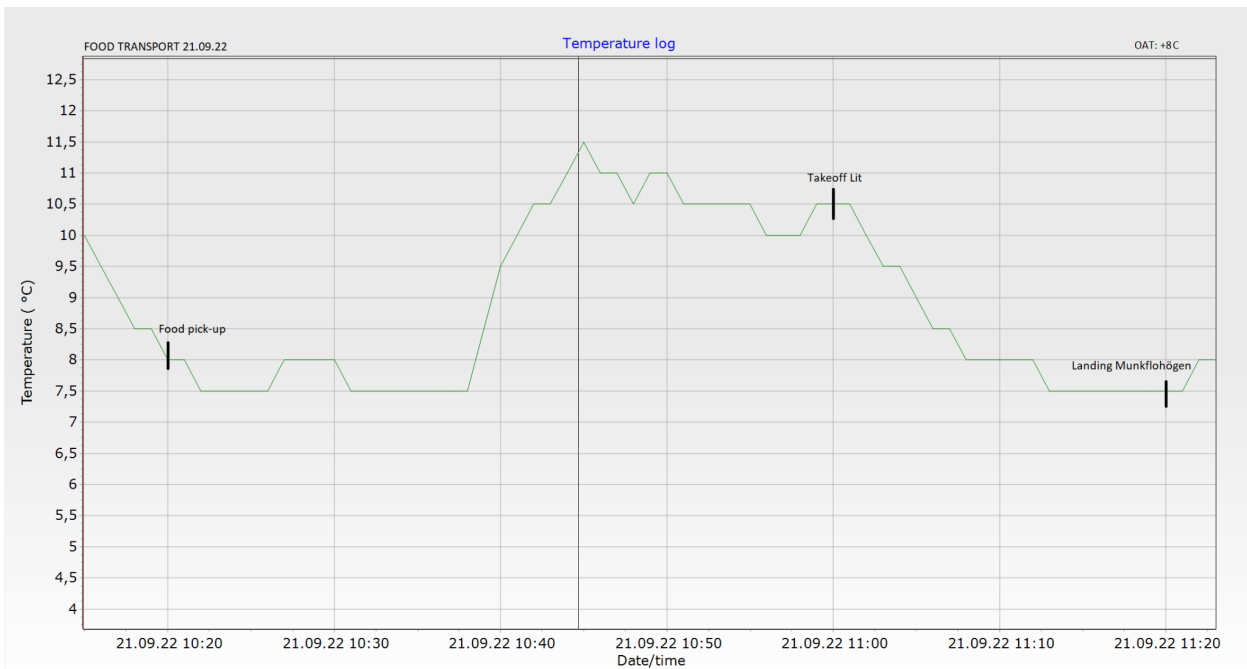


Food was transported from Lit to Munkflohögen and Österåsen. The food transport was an attempt to deliver food with drones instead of it being transported to the patient by car. Three deliveries were performed, two to Munkflohögen and one to Österåsen. As the food boxes could not be opened to insert a temperature probe, the temperature was measured on the outer surface of the food box.

Winching during BVLOS operations was not allowed at the time of the project, so the food was transported inside the drone.

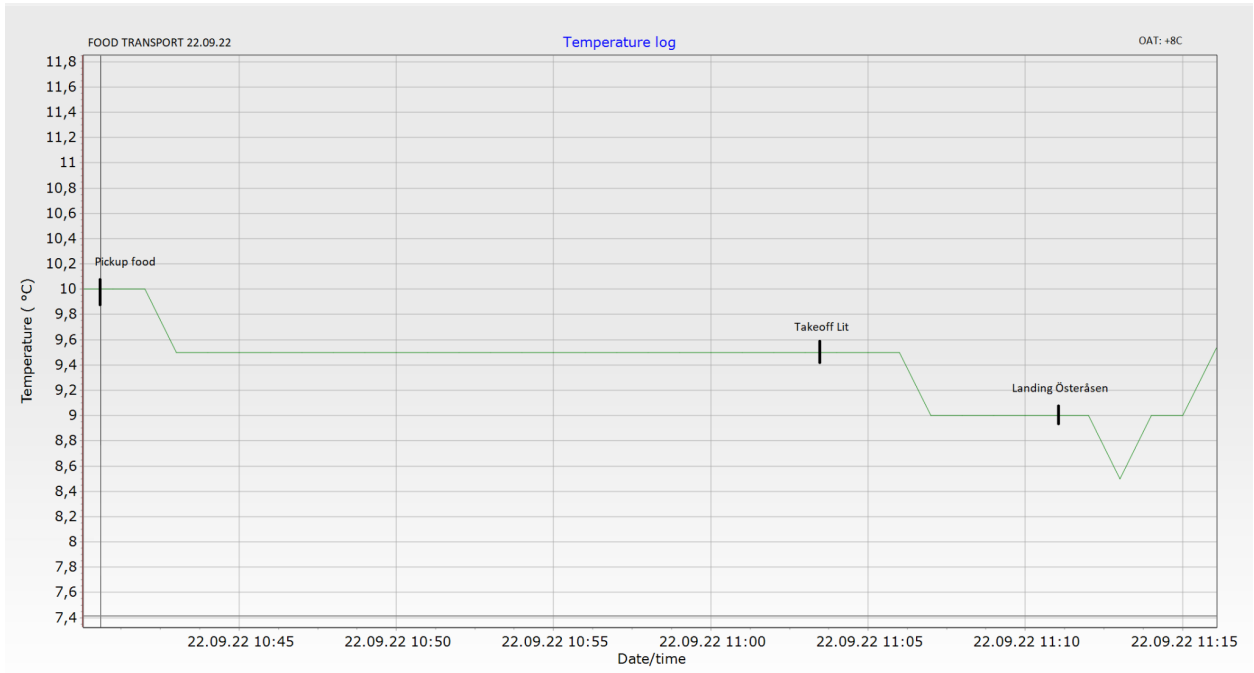
The Swedish Radio, SR P4, was broadcasting live from the arrival site during one of the deliveries.

Food transport to Munkflohögen 21.09.22





Food transport to Österåsen 22.09.22

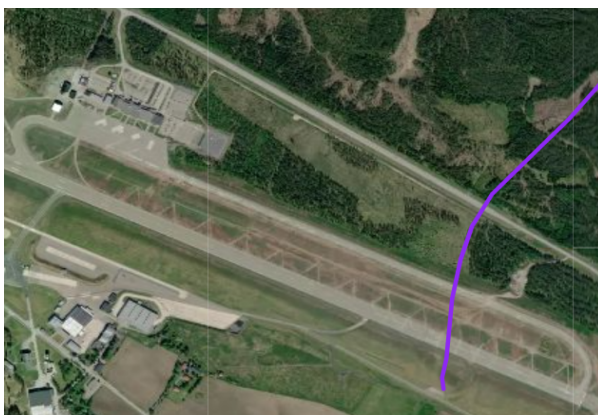


Drone flights from Åre Östersund Airport to Ås 13.09.2022



As mentioned earlier in the report, there was a lot of coordination and questions before operating from the airside of the airport and occupying several sectors simultaneously inside the CTR. In the first place Swedish aviation authority thought it would not be possible to occupy the controlled airspace with such a short notice. However, with collaboration with Aviant and the authorities this was considered safe.

On the day of the flight, operations were carefully planned and organized to run smoothly in between other IFR traffic. The flights proceeded smoothly and took approximately 40 minutes to Ås and back to the airside of the airport. The drone landed in Ås for a battery change.



Launch and landing points were decided to be placed far away from terminals, hangars and airport hotspots to allow for good preparations inside the airport. This allowed Aviant crew to have good time to prepare the drone while other traffic operated inside the airport area.

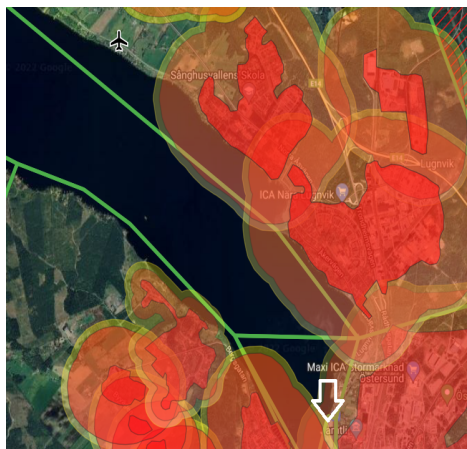
Conclusion

All the food, medicine and blood transports were successful and the distances were relatively short. The flights took about the same time as traveling by car. Since the drone requires more preparation, it becomes difficult to compare these means of transport to each other. In order to be able to compare with road transport in terms of time. The transport distances should be longer. Longer distances would also provide more realistic temperature measurements during the flights.

Blood transport boxes need to be developed to the extent that it can maintain a preset temperature that is controlled during the transport inside a drone. The same applies to food transport. The aim in this project was to winch the food to the ground but unfortunately this was not possible at this time due to regulatory restrictions. However, winching may be possible in the near future.

Coordination was made with the commercial entities before the project was initiated early in the process when the restriction area was applied for. In earlier projects it has been a procedure to coordinate restriction area activation times and planned times of operations with the entities, but due to the VMC condition which allowed for passage over the restriction area, this was not an issue in the end. However, the planned operation times published gave the drone operations less time due to meteorology.

This project has challenged both regulations and authorities. It can clearly be seen that some Swedish authorities have still not adapted regulations to commercial drone operations. For instance, one Swedish authority was not aware that drones might have a registration and considered as a drone for commercial purposes.



All preparations were completed to apply for flying into Jamtli Brygga. Since the restriction area and CTR had a lot of conditions it was considered a risk to add even more procedures to the pilot. This is because the area is close to the city center and the ambulance helicopter base is less than 500 meters from the planned landing site. For future projects flying into the hospital roof or Jamtli Brygga can be considered with new allowances and procedures. Seen in the image is the landing site south of Ås and Jamtli Brygga represented by the white arrow. This image shows the fixed wing risk assessment and the boundaries (in red) of flying close to the city.