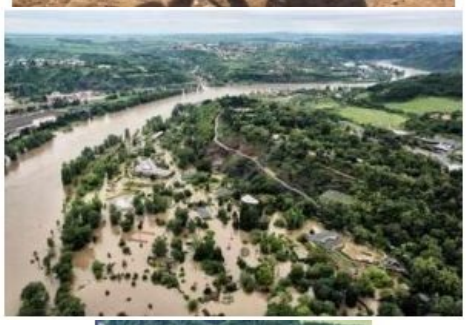
MONITORING FLOODING AND ASSESSING DAMAGE IN THE CZECH REPUBLIC

UAS and Flooding



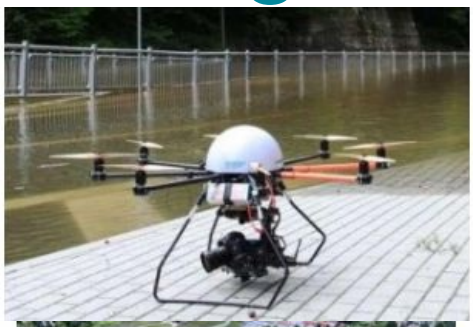


Figure 1, MD4-1000 from microdrones.

Heavy rainfall in late May and early June 2013 caused the Elbe, Vltava and Kamenice rivers to burst their banks in the Czech Republic. Among other areas, the Troja area of Prague and the villages of Hrensko and NovÃ© Kopisty were severely flooded. Here, the author describes the experiences gained by the Czech company Geodis while using UAS technology to monitor and assess the impact of floods for the first time. Having proved that it can provide geodata quickly, cheaply and efficiently, UAS is now attracting significant interest from authorities.

Geodis is the producer of the countrywide orthoimagery, resolution 12.5cm, and the Digital Elevation Model (DEM), with grid spacing of 10m, of the entire Czech Republic. The revision cycle of both products is three years. The company has monitored large-scale floods in the Czech Republic since 1997 – mainly by traditional airborne photogrammetry, up until 2013. Products derived from overlapping aerial imagery such as georeferenced orthomosaics, DEMs, flood levels and maps of waterways support water boards, municipalities and other authorities in taking flood prevention measures and in decision-making when flooding has occurred.

UAS Ownership

Since 2012, Geodis is the owner of two types of UAS: the quadrocopter MD4-1000 (Figure 1) from the company microdrones and an octocopter developed in-house (Figure 2). Both systems are equipped with GNSS, gyroscopes, accelerometers and compasses. They are used in a variety of projects which are often carried out in co-operation with research institutions and universities. The MD4-1000, equipped with a Canon EOS 5D Mark III, has a maximum speed of 12m/s, can stay airborne for 25 minutes, weighs 6.2kg with sensor on board and can carry a load of up to 1.5kg. The 22MP Canon camera contains a high-quality chip and is able to capture HD video. The octocopter developed in-house has a maximum speed of 15m/s, can stay airborne for 15 minutes with the above-mentioned Canon EOS 5D Mark III on board, weighs 9.5kg and can carry a load of up to 6kg. The ability to carry a relatively large and heavy payload of 6kg is advantageous for capturing inaccessible areas with a pallet of sensors, including thermal infrared sensors and multispectral and professional cameras. Other features include retractable legs and a remote-controlled camera which is wirelessly connected to a monitor, thus allowing the operator to follow the flight in real time. The rotation of the camera around three axes can be steered by the operator and allows dynamic shots which can be directly transmitted to authorities for decision-making purposes. The flight path of the octocopter can be either steered by remote control or pre-specified in a flight plan.

Figure 2, Geodis Geocopter G8.

Flood Monitoring

Floods have a significant impact on the local environment and the people living there. In the case of a flood, authorities need information on the extent of the flooding, its rate of expansion or contraction, the number of people in the endangered areas, their ages and their addresses. Is anyone injured or dead, do they need medical care, should basic necessities be distributed? Important decisions to be taken

include whether to evacuate people, their livestock and possessions to higher ground, or whether to inundate sparsely populated lowlands upstream in order to bring relief to densely populated areas. The process of collecting information may be severely hindered by inaccessibility of the area. Meanwhile, citizens may want to be kept informed about the situation by television channels and the internet. For some rescue tasks, information gained through human observations alone may suffice. Other tasks require calculations and the newly collected data to be combined with existing maps and DEMs; in other words, the imagery should have a high spatial resolution and be rectified and georeferenced. Fortunately, today's photogrammetric software allows automatic generation of orthomosaics and DEMs to become available soon after the imagery has been recorded.

Taking Action

When flooding was threatening the river areas in the north western part of the country in late spring 2013, mobile mapping systems, manned aircrafts and UAS were deployed to collect geodata both from the ground and from the air. The use of UAS for monitoring such floods was new

Figure 3, Prague: flooded zoo (up) and Troja Castle.

for the Czech Republic and proved to be very valuable. The extent of the flooded areas was relatively small, making them easy to cover using a UAS. For example, the area that had to be monitored along the River Vltava in Prague measured just 1km² (Figure 3). The video facility allowed instantaneous visual inspection by experts located near the flooded site or in crisis centres. The video images were also recorded and edited for broadcast by the national television network to inform the general public. For the creation of orthomosaics, DEMs and stereo views, overlapping images were taken at a height of 60m resulting in a ground sampling distance (GSD) of 1cm. The overlaps were 80% along track and 60% across track. For accurate georeferencing purposes, ground control points were measured or adapted from existing geodatabases. The resulting orthomosaics had a GSD of 3cm, while the GSD of the DEMs was 10cm.

Inaccessible

Since a UAS can fly at low altitudes, it can capture flooded sites in the presence of continuous rain and cloud cover. In the same conditions, traditional aerial surveys carried out by manned helicopters or aeroplanes are impossible. The systems are easily portable, allowing them to be transported to flood sites simply and cheaply. Add to this their cost-effective operation and the fact that they can be quickly prepared for operation once on site, and it should come as no surprise that the Czech authorities are showing great interest in using UAS technology in crisis situations.

Hřensko, a village located close to Germany at the confluence of the River Kamenice with the Elbe, was completed surrounded by water and almost the entire population was evacuated, although a dozen or so people refused to leave their homes (Figure 4). Regular UAS recording of this completely isolated village was the only way to monitor the extent of the flooding and to assess the steadily increasing damage.

Another inaccessible village was Nové Kopisty which lies on a plane where the River Eger flows into the Elbe. A dam failure created a large lake around the entire village, cutting it off from its surroundings. Flooded parts of the village had to be evacuated. Here, too, UAS proved to be an excellent tool for monitoring inaccessible terrain and for providing emergency services and electronic media with aerial images, videos and orthoimagery very rapidly.

Figure 4, Hřensko, situated at the confluence of the River Kamenice with the Elbe.

Permits

All UAS surveys have to be registered at the Civil Aviation Authority (CAA). The various types of UAS are categorised according to their weight and usage. The weight categories are: up to 0.91kg, 0.91-7kg, 7-20kg, and above 20kg. The two types of use are recreational/sport and commercial/research. Registration is compulsory for both. The UAS should always be in line of sight of the pilot who should be licensed.

Concluding Remarks

UAS technology not only enables the collection of accurate and timely geodata but may also help to find missing persons and to protect shops, businesses and homeowners from illegal appropriation of goods.