Article

Rapid Aerial Mapping Methods for

Traditional and New Achievements in Hungary

By Zsolt Molnár and Gábor Bakó

Aerial mapping methods in Hungary are essential for flood prevention. This article describes recent aerial flood mapping methods and results, as well as the advantages of recent technological developments with regards to aerial mapping.

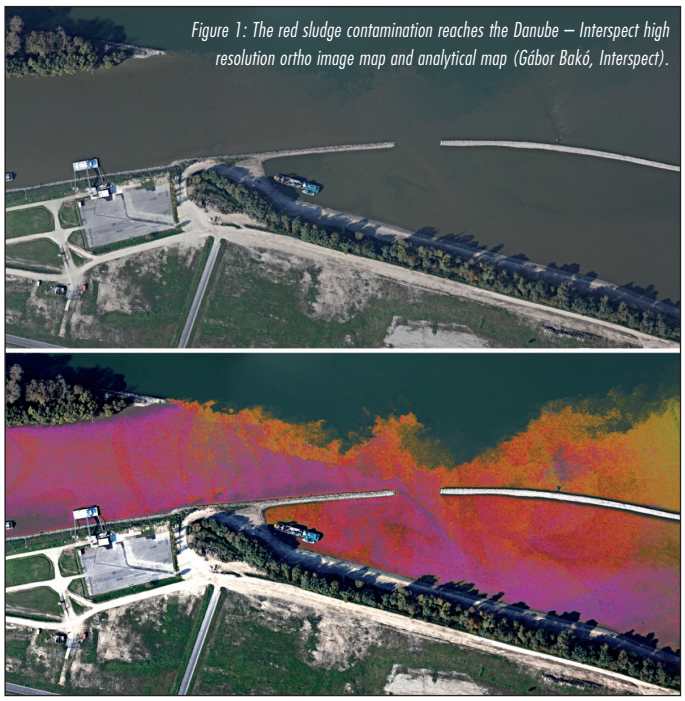

Figure 1: The red sludge contamination reaches the Danube – Interspect high resolution ortho image map and analytical map (Gábor Bakó, Interspect).

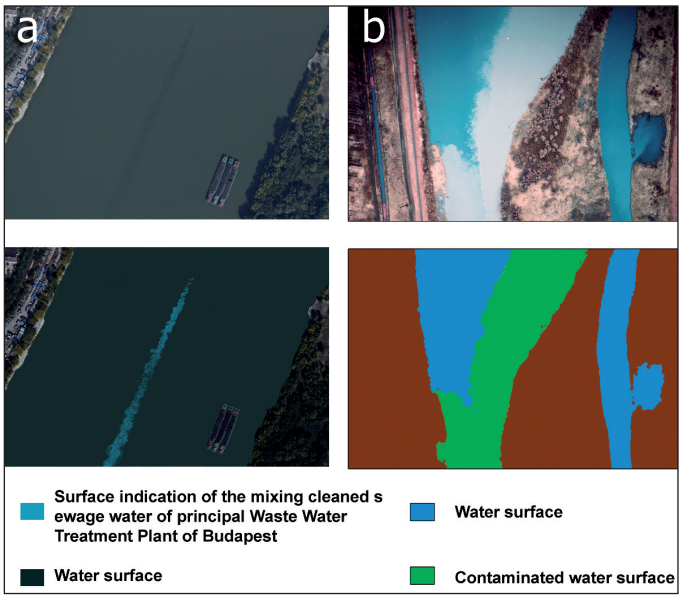

Figure 2: Hydrodynamic and blending studies: a, In the ortho image mosaic and thematic map the treated wastewater blends into the Danube; b, Archive image of metallic pollution of the Tisza (2000) and its analysis by modern methods (Gábor Bakó – Zsolt Molnár – Judit Kirisics).

Introduction

In Hungary, the topographic and hydrologic characteristics of the Carpathian Basin have resulted in its watercourses, lakes and inland waters, which are specific to this area, strongly influencing the landscape structure. This, in turn, has had significant consequences for agriculture and industry. Additionally, this means that, in this middle section of Danube Basin, serious consideration should be given to flood prevention in order to control and maintain the condition of embankments and related structures.

For professionals, the fast aerial mapping methods provide the most practical solution to this, in combination with field validation and additional measurements. In addition to this sort of ongoing supervision, the preservation of water purity requires its own series of developments. High resolution aerial surveys allowing the early detection of contamination sources and anomalies are carried out for rapid intervention and risk reduction. Aerial surveys have been conducted continuously since the 1960s; the most current results of these have been collected here.

Aerial flood mapping

The condition of surface water bodies is studied by several methods. Contamination and the presence and concentration of different metallic and organic contaminants in the water sample are determinable by on-site and laboratory measurements.

However, numerous measurements should be carried out to be representative for the entire water body. Therefore, since the 1970s the on-site sampling has been combined with aerial surveys with which the spatial occurrence of contamination can be detected. This method is only successful for surface water bodies, as the passive optical sensors are not able to see into the soil and the groundwater can only be indirectly inferred.

In Hungary the aerial flood mapping began in the 1920s; the environmental usage of aerial photo mosaics was started in the 60s and 70s and, at this time, they also began to recognize the importance of infrared aerial photography.

The Water Management Aerial Service (later ARGOS Studio), the basic organization of Hungarian aerial water management and aerial environmental surveys played a significant role in this. As a water management aerial service, it has conducted nationwide activities since the 70s. Its successor, the INTERSPECT, still continues to deal with nature conservation, environmental monitoring and ecological research and development activities with multispectral calibrated aerial cameras.

Water Management

Figure 6: In a traditional aerial image (the upper left corner), the contamination can easily be mistaken for a sand bank or accumulated branches. In the high resolution image the problem is clearly interpretable and localizable (Ortho image map section of the Soroksár Danube branch – Gábor Bakó, Interspect).

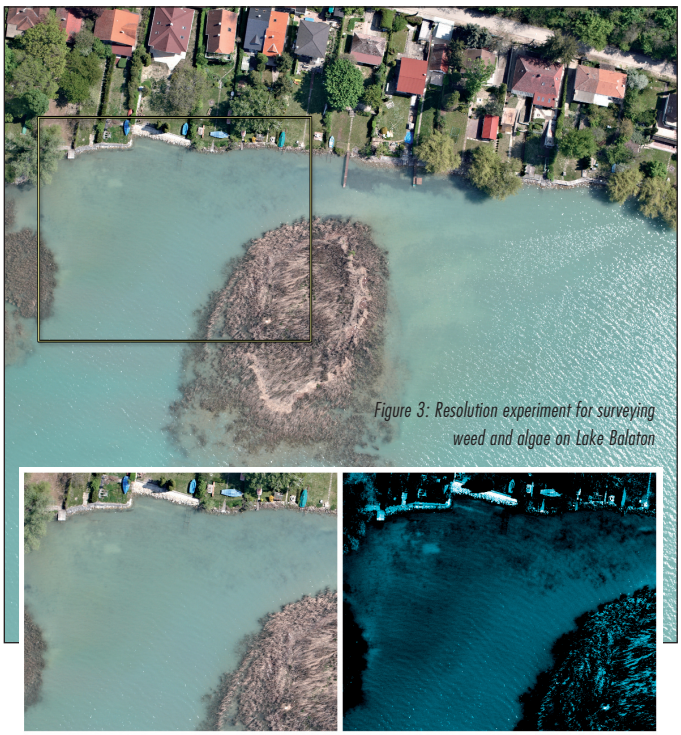

Figure 3: Resolution experiment for surveying weed and algae on Lake Balaton

The advantageous cartographic data collected by aircraft was also used previously for flood mapping, to find weakened, poorly functioning water facilities, to conduct hydrodynamic tests and localize pollution sources.

Current results

It is worth mentioning that the results of the last few years, since the red sludge disaster in 2010, have been useful for the monitoring of the sludge flowing into the Danube. (Figure 1), the controlling of wastewater treatment plants (Figure 2), surveying weed and algae on Lake Balaton (Figure 3) and detecting contaminations (Figure 4). The interpretation of high resolution ortho images can be highly automated. The result depends primarily on image quality (good density, hue reproduction, geometric and spatial resolution and noise-free). The aerial survey of the Danubian flood of 2013 resulted in very positive results from the new experimental Interspect IS 4 multispectral aerial camera (Figure 5).

Due to the rapid development of technology and today's quick and high resolution imagery, even minor signs of organic substances leaking into the water are detectable. This has inspired the Interspect Group to develop different scientific methods for the different contamination types.

The organic substance accumulation zones are clearly delineated on slow flowing and standing water surfaces. The illegal wastewater is noticeable too, even if it occurs in small areas, which would not normally be visible in traditional aerial images lower than 10 cm (Figure 6). These contamination sources may have large water discharge, which could cause significant environmental contamination.

The quick selection of critical areas saves a great deal of time, field work and financial investment and allows the inclusion of less accessible areas, which, in the past, would not have been tested by on-site evaluation.

It is not only the vegetation, the edifices, the agriculture and the contaminants which can be mapped, but also hydrodynamic studies can be conducted. Additionally, the condition of piers and sluices can be checked. The 3D model is a spin-off of photogrammetric image processing (Figure 7), but it supplies a useful input for models and 3D environment geo databases.

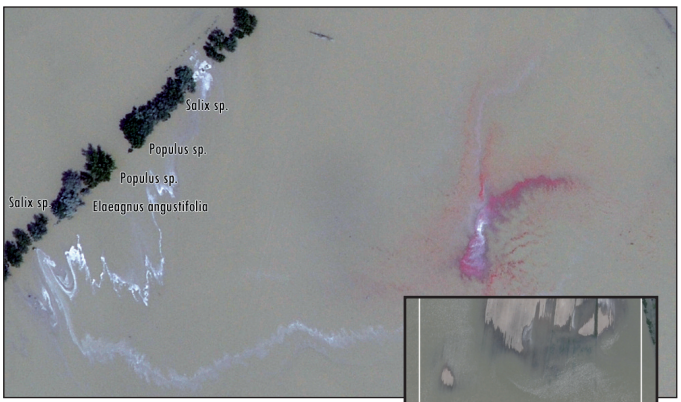

Figure 4: The aerial flood survey has recorded a substantial portion of contamination in the flood (Chemicals wash out near Tass, Hungary – Gábor Bakó, Interspect).

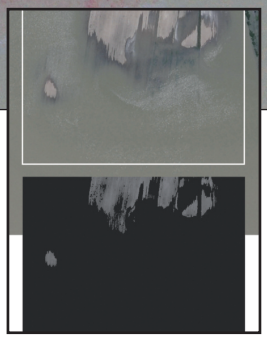

Figure 5: Ortho image detail and the results obtained by image classification (Zsolt Molnár – Gábor Bakó, Interspect).

Zsolt Molnár is a photogrammetric technician and is the technological director of Interspect Research Group, which is involved in planning multispectral camera and in field and aerial surveys.

Gábor Bakó is an engineer and remote sensing specialist, who is the head of the Interspect Research Group.. More about Interspect: www.interspect.hu.

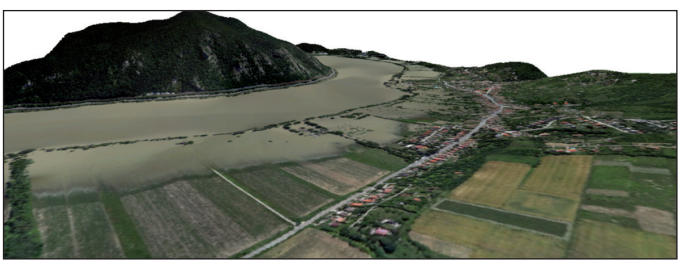

Figure 7: The ortho image mosaic of the Danubian flood of 2013 near Nagymaros in 3D -Gábor Bakó, Interspect.