CHAPTER 8

DRONE APPLICATIONS IN GEOGRAPHY: GAME OF DRONES

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INTRODUCTION

The study of geography requires the ability to acquire, represent and interpret spatial data. Over the last decades, the quality and availability of satellite imagery and aerial photos have rapidly increased and these have provided substantial sources for learning and teaching in geography (Williams et al., 2017). Although fieldworks remain an important part of data observation and acquisition in recent decades, new "tools" have been developed to capture, record and even measure geographical phenomena from the air (Casagrande, 2018a).

Unmanned air vehicles (UAV), often used interchangeably with the term "drones" (Dynamic Remotely Operated Navigation Equipment) are aircrafts that can fly autonomously. However, there is a slight difference between the two. A UAV is an unmanned aerial vehicle while a drone is an unmanned vehicle operating in the air, on land, or underwater. In this paper we prefer to use the term "drone" since it has wider content.

The history of drones starts just after World War I with a UAV called "British DH 82B Queen Bee" that was developed by British Royal Navy. In 1935, U.S. admiral William H. Standley was present at the demonstration of the remotely controlled aircraft and tasked one of his commanders to develop a similar one. The commander, Delmer Fahrney, called the aircraft that he developed a "drone", an Old English word used for "male bee" in reference to the British Queen Bee (Keane and Carr, 2013). The usage of the term made an appearance in the Oxford English Dictionary in 1946 and Encyclopedia Britannica in 1947 (Clarke, 2014). The extensive use of drones as surveillance or weapon systems for military purposes paved the way for this technology to be used commercially in recent times. Current drones derive from military prototypes, but they are equipped with newer technologies.

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guidance from a central computer or human. Nevertheless, the potential should be discovered through geography research collaborations aimed at socially, politically and legally situating new and emerging drone methodological practices.

CONCLUSION

The increasing demand and use of drones have brought about a revolution in remote sensing and geography. Drones are not only "the eyes in the sky" but also a volumetric and vertical data source. Field data is still essential for geographers but combining it with drone-based imagery and data enhances the scientific studies. Today, the occurrence of SfM algorithms and powerful hardware make it possible to obtain very high resolution (both spatial and temporal) 3D data more easily and without the need for high processing skills. With the use of pre-existing remote sensing techniques such as object-based image analysis or neural network-based classifications, geographers can adopt the drone data for spatial "information".

It should be accepted that drone applications in physical geography has much wider concept than human geography due to the nature of both disciplines. In this paper, we have tried to give researchers information about the foregoing drone applications and its potential to enhance geography research. Using drones for geography research shouldn't be considered as 2D view of earth. Collection of point clouds for 3D for natural and human made objects easily and rapidly have already enhanced our understanding of space and will increasingly go on.

REFERENCES

ABC News (2019 September 30) Drone journalism takes off, Retrieved from https://www.abc.net.au/news/2012-02-21/drone-journalism-takes-off/3840616.

Amazon Prime Air. (2019 September 30). Retrieved from https://www.amazon.com/Amazon-Prime-Air/b?ie=UTF8&node=8037720011.

Arjomandi A., Agostino S., Mammone M., Nelson M., & Zhou T. (2006) Classification of unmanned aerial vehicle, Report for Mechanical Engineering class, University of Adelaide, Adelaide, Australia

Bangen, S.G., Wheaton, J.M., Bouwes, N., Bouwes, B. & Jordan, C. (2014). A method- ological intercomparison of topographic survey techniques for characterizing wadeable streams and rivers. Geomorphology, 206, 343–361.

Berman, E. S., Fladeland, M., Liem, J., Kolyer, R., & Gupta, M. (2012). Greenhouse gas analyzer for measurements of carbon dioxide, methane, and water vapor aboard an unmanned aerial vehicle. Sensors and Actuators B: Chemical, 169, 128-135.

Brooke-Holland L. (2012). Unmanned Aerial Vehicles (drones): An Introduction, House of Commons Library, UK.

Candiago, S., Remondino, F., De Giglio, M., Dubbini, M., & Gattelli, M. (2015). Evaluating multispectral images and vegetation indices for precision farming applications from UAV images. Remote sensing, 7(4), 4026-4047.

Carrivick, J. L., Smith, M. W., & Quincey, D. J. (2016). Structure from Motion in the Geosciences. John Wiley & Sons.

Casagrande G. (2018a). Small Drones and Geographic Observation, in Casagrande, G., Sik, A., & Szabó, G. (Eds.). (2018). Small Flying Drones. Springer.

Casagrande G. (2018b). Opportunities, in Casagrande, G., Sik, A., & Szabó, G. (Eds.). (2018). Small Flying Drones. Springer.

Chandler, B. M., Lovell, H., Boston, C. M., Lukas, S., Barr, I. D., Benediktsson, Í. Ö., ... & Ewertowski, M. W. (2018). Glacial geomorphological mapping: A review of approaches and frameworks for best practice. Earth-Science Reviews, 185, 806-846.

Chen, B., Chen, Z., Deng, L., Duan, Y., & Zhou, J. (2016). Building change detection with RGB-D map generated from UAV images. Neurocomputing, 208, 350-364.

Duarte, D., Nex, F., Kerle, N., & Vosselman, G. (2017). Towards a more efficient detection of earthquake induced facade damages using oblique UAV imagery. The International Archives of Photogrammetry, Remote Sensing and Spatial Information Sciences, 42, 93.

Clarke, R. (2014). Understanding the drone epidemic. Computer Law & Security Review, 30(3), 230-246.

Eltner, A., Baumgart, P., Maas, H. G., & Faust, D. (2015). Multi-temporal UAV data for automatic measurement of rill and interrill erosion on loess soil. Earth Surface Processes and Landforms, 40(6), 741-755.

Evans, D. J. A., Ewertowski, M. & Orton, C. (2016) Fláajökull (north lobe), Iceland: active temperate piedmont lobe glacial landsystem, Journal of Maps. 12(5), pp. 777–789.

Financial Times. (2019 September 30) Saudi oil attack highlights Middle East's drone war, Retrieved from https://www.ft.com/content/f2a73b40-d920-11e9-8f9b-77216ebe1f17.

Forbes. (2020 April 14) Robots and Drones Are Now Used To Fight COVID-19, Retrieved from https://www.forbes.com/sites/bernardmarr/2020/03/18/how-robots-and-drones-are-helping-to-fight-coronavirus/.

Gallay, M. (2013) Direct acquisition of data: airborne laser scanning. In: L.E. Clarke & J.M. Nield (eds), Geomorphological Techniques (Online Edition). British Society for Geomorphology, London.

Getzin, S., Wiegand, K., & Schoning, I. 2012. Assessing Biodiversity in Forests Using very High-Resolution Images and Unmanned Aerial Vehicles. Methods Ecological Evolution, 3(2), 397-404.

Gitelson, A. A., Kaufman, Y. J., Stark, R., & Rundquist, D. (2002). Novel algorithms for remote estimation of vegetation fraction. Remote sensing of Environment, 80(1), 76-87.

Gulf News. (2020 April 14) COVID-19: Drones take Italians' temperature and issue fines, Retrieved from https://gulfnews.com/world/europe/covid-19-drones-take-italians-temperature-and-issue-fines-1.70918116.

Hassanalian, M., & Abdelkefi, A. (2017). Classifications, applications, and design challenges of drones: A review. Progress in Aerospace Sciences, 91, 99-131.

Hochmair, H. H., & Zielstra, D. (2015). Analysing user contribution patterns of drone pictures to the dronestagram photo sharing portal. Journal of Spatial Science, 60(1), 79-98.

Honjo, T., Tsunematsu, N., Yokoyama, H., Yamasaki, Y., & Umeki, K. (2017). Analysis of urban surface temperature change using structure-from-motion thermal mosaicing. Urban Climate, 20, 135-147.

Jensen, J. L. R. and Mathews, A. J. (2016) Assessment of image-based point cloud products to generate a bare earth surface and estimate canopy heights in a woodland ecosystem, Remote Sensing, 8(1).

Johnson, K., Nissen, E., Saripalli, S., Arrowsmith, J. R., McGarey, P., Scharer, K., Williams, P., & Blisniuk, K. (2014). Rapid mapping of ultrafine fault zone topography with structure from motion. Geosphere, 10(5), 969-986.

Jordan, B. R. (2015). A bird's-eye view of geology: The use of micro drones/UAVs in geologic fieldwork and education. GSA Today, 25, 42–43.

Kachamba, D., Ørka, H., Gobakken, T., Eid, T., & Mwase, W. (2016). Biomass estimation using 3D data from unmanned aerial vehicle imagery in a tropical woodland. Remote Sensing, 8(11), 968.

Kalantar, B., Mansor, S. B., Sameen, M. I., Pradhan, B., & Shafri, H. Z. (2017). Drone-based land-cover mapping using a fuzzy unordered rule induction algorithm integrated into object-based image analysis. International journal of remote sensing, 38(8-10), 2535-2556.

Kayen, RE, Gori, S., Lingwall, B., Galadini, F., Falcucci, E., Franke, K., Stewart J., & Zimmaro P. (2018). Mt. Vettore Fault Zone Rupture: LIDAR- and UAS-Based Structure-From-Motion Computational Imaging, 16th European Conference on Earthquake Engineering.

Keane, J. F., & Carr, S. S. (2013). A brief history of early unmanned aircraft. Johns Hopkins APL Technical Digest, 32(3), 558-571.

King, L. M. (2014). Will drones revolutionise ecotourism?. Journal of Ecotourism, 13(1), 85-92.

Kuuluvainen, H., Poikkimäki, M., Järvinen, A., Kuula, J., Irjala, M., Dal Maso, M., ... & Rönkkö, T. (2018). Vertical profiles of lung deposited surface area concentration of particulate matter measured with a drone in a street canyon. Environmental Pollution, 241, 96-105.

Lehmann, J. R. K., Nieberding F., Prinz T., & Knoth C. (2015). Analysis of Unmanned Aerial System- Based CIR Images in Forestry - A New Perspective to Monitor Pest Infestation Levels. Forests, 6(3): 594–612.

Lei, M., Manchun, L., Yafei, W., Lihua, T., & Liang, C. (2013). Using high-resolution imagery acquired with an autonomous unmanned aerial vehicle for urban construction and planning. In 2013 the International Conference on Remote Sensing, Environment and Transportation Engineering (RSETE 2013). Atlantis Press.

Li, H., Chen, L., Wang, Z. & Yu, Z. (2019) Mapping of River Terraces with Low-Cost UAS Based Structure-from-Motion Photogrammetry in a Complex Terrain Setting. Remote Sensing, 11, 464.

Li, M., Zang, S., Zhang, B., Li, S., & Wu, C. (2014). A review of remote sensing image classification techniques: The role of spatio-contextual information. European Journal of Remote Sensing, 47(1), 389-411.

Li, Y., & Liu, C. (2019). Applications of multirotor drone technologies in construction management. International Journal of Construction Management, 19(5), 401-412.

Lindner, G., Schraml, K., Mansberger, R., & Hübl, J. (2016). UAV monitoring and documentation of a large landslide. Applied Geomatics, 8(1), 1-11.

Lisein, J., M. Pierrot-Deseilligny, S. Bonnet, & P. Lejeune. (2013). A Photogrammetric Workflow for the Creation of a Forest Canopy Height Model from Small Unmanned Aerial System Imagery. Forests, 4(4): 922–944.

Lucieer, A., Jong, S. M. d. & Turner, D. (2014) Mapping landslide displacements using Structure from Motion (SfM) and image correlation of multi-temporal UAV photography, Progress in Physical Geography, 38(1), 97–116.

Maes, W., Huete, A., & Steppe, K. (2017). Optimizing the processing of UAV-based thermal imagery. Remote Sensing, 9(5), 476.

McGonigle, A. J. S., Aiuppa, A., Giudice, G., Tamburello, G., Hodson, A. J., & Gurrieri, S. (2008). Unmanned aerial vehicle measurements of volcanic carbon dioxide fluxes. Geophysical research letters, 35(6).

Messinger, M., Asner, G., & Silman, M. (2016). Rapid assessments of Amazon forest structure and biomass using small unmanned aerial systems. Remote Sensing, 8(8), 615.

Michez, A., H. Piégay, J. Lisein, H. Claessens, & P. Lejeune. (2016). Classification of Riparian Forest Species and Health Condition Using Multi-Temporal and Hyperspatial Imagery from Unmanned Aerial System. Environmental Monitoring and Assessment 188(3): 1–19.

Mirk, D., & Hlavacs, H. (2015). Virtual tourism with drones: experiments and lag compensation. in Proceedings of the First Workshop on Micro Aerial Vehicle Networks, Systems, and Applications for Civilian Use (pp. 45-50). ACM.

Mogili, U. R. & Deepak, B. B. V. L. (2018) Review on Application of Drone Systems in Precision Agriculture, in Procedia Computer Science.

Naughton, J., & McDonald, W. (2019). Evaluating the variability of urban land surface temperatures using drone observations. Remote Sensing, 11(14), 1722.

Nex, F., & Remondino, F. (2014). UAV for 3D mapping applications: a review. Applied geomatics, 6(1), 1-15.

de Paul O. V. (2007). Remote Sensing: New Applications for Urban Areas, Proceedings of the IEEE, vol. 95, no. 12, pp. 2267-2268.

Ölgen M. K., Yavaşlı D.D. (2019) Delta Jeomorfolojisinde İnsansiz Hava Araçları Uygulamaları: Bakırçay Deltası Örneği, in UJES Uluslarası Jeomorfoloji Sempozyumu, Ankara.

Palanirajan, H. K., Alsadik, B., Nex, F., & Oude Elberink, S. (2019). Efficient Flight Planning for Building Façade 3D Reconstruction. International Archives of the Photogrammetry, Remote Sensing & Spatial Information Sciences.

Pirjola, L., Lähde, T., Niemi, J. V., Kousa, A., Rönkkö, T., Karjalainen, P., ... & Hillamo, R. (2012). Spatial and temporal characterization of traffic emissions in urban microenvironments with a mobile laboratory. Atmospheric Environment, 63, 156-167.

Popular Mechanics. (2020 April 14) Police Are Using Drones to Yell at People for Being Outside, Retrieved from https://www.popularmechanics.com/technology/a31708776/police-drones-social-distancing-coronavirus/.

Popular Science. (2019 September 30) Flytrex Drone Transports Beers, Sandwiches, Other Basic Necessities, Retrieved from https://www.popsci.com/new-delivery-drone-can-carry-one-beer/.

Rasmussen, J., Ntakos, G., Nielsen, J., Svensgaard, J., Poulsen, R. N., & Christensen, S. (2016). Are vegetation indices derived from consumer-grade cameras mounted on UAVs sufficiently reliable for assessing experimental plots?. European Journal of Agronomy, 74, 75-92.

Reich, M., Wiggenhagen, M., & Muhle, D. (2012). Filling the holes–potential of UAV-based photogrammetric façade modelling. Tagungsband des, 15, 147-156.

Simic Milas, A., Cracknell, A. P. & Warner, T. A. (2018) Drones–the third generation source of remote sensing data, International Journal of Remote Sensing. 39(21), 7125–7137.

Smith, M. W., & Vericat, D. (2015). From experimental plots to experimental landscapes: topography, erosion and deposition in sub-humid badlands from structure-from-motion photogrammetry. Earth Surface Processes and Landforms, 40(12), 1656-1671.

Stagakis, S., Burud, I., Thiis, T., Gaitani, N., Panagiotakis, E., Lantzanakis, G., ... & Chrysoulakis, N. (2019). Spatiotemporal monitoring of surface temperature in an urban area using UAV imaging and tower-mounted radiometer measurements. In 2019 Joint Urban Remote Sensing Event (JURSE) (pp. 1-4). IEEE.

Suran, N. A., Shafri, H. Z. M., Shaharum, N. S. N., Radzali, N. A. W. M., & Kumar, V. (2019). Uav-Based Hyperspectral Data Analysis for Urban Area Mapping. International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences, 42(4/W16).

Surmann, H., Worst, R., Buschmann, T., Leinweber, A., Schmitz, A., Senkowski, G., & Goddemeier, N. (2019). Integration of UAVs in Urban Search and Rescue Missions. in 2019 IEEE International Symposium on Safety, Security, and Rescue Robotics (SSRR) (pp. 203-209). IEEE.

Tech Times. (2020 April 14) FAA Predicts Drones Will Number 7 Million By 2020, Retrieved from http://www.techtimes.com/articles/144405/20160326/faa-predicts-drones-will-number-7-million-by-2020.htm.

Thon, S., Serena-Allier, D., Salvetat, C., & Lacotte, F. (2013). Flying a drone in a museum: An augmented-reality cultural serious game in Provence. In 2013 Digital Heritage International Congress (DigitalHeritage) (Vol. 2, pp. 669-676). IEEE.

Van Tilburg, C. (2017). First report of using portable unmanned aircraft systems (drones) for search and rescue. Wilderness & environmental medicine, 28(2), 116-118.

Watai, T., Machida, T., Ishizaki, N., & Inoue, G. (2006). A lightweight observation system for atmospheric carbon dioxide concentration using a small unmanned aerial vehicle. Journal of Atmospheric and Oceanic Technology, 23(5), 700-710.

Watts A.C., Ambrosia V.G., & Hinkley E.A. (2012) Unmanned aircraft systems in remote sensing and scientific research: classification and considerations of use, Remote Sensing, 4(6), 1671–1692.

Weibel R.E., & Hansman R.J. (2004) Safety considerations for operation of different classes of

UAVs in the NAS, in Proceedings of the 4th Aviation Technology, Integration and Operations Forum, AIAA 3rd Unmanned Unlimited Technical Conference, Workshop and Exhibit.

Williams, R. D., Tooth, S. & Gibson, M. (2017) The sky is the limit: reconstructing physical geography from an aerial perspective, Journal of Geography in Higher Education, 41(1), 134–146.

Yu, F., Liu, Y., Fan, L., Li, L., Han, Y., & Chen, G. (2017). Design and implementation of atmospheric multi-parameter sensor for UAV-based aerosol distribution detection. Sensor Review, 37(2), 196-210.