KAZAVA Kavango-Zambezi Vulnerability and Adaptation

Unmanned Aerial Systems Research

Project Overview: The Kavango-Zambezi Vulnerability and Adaptation (KAZAVA) initiative is an interdisciplinary research program studying how communities and their households, land use, and climate interact to create or mitigate vulnerability in the Kavango-Zambezi Transfrontier Area of Southern Africa.

We aim to facilitate a broader understanding of how livelihoods, land use and its history, and the environment are changing in this region. Our team collaborates with partner organizations and team members from the U.S., Botswana, Zambia, and Namibia.

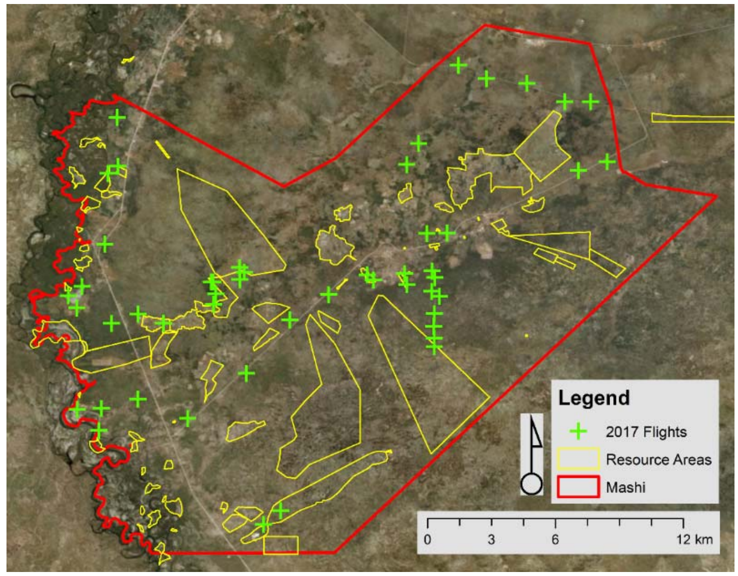
In 2017 and 2018, the KAZAVA team conducted aerial surveys using an Unmanned Aerial System (UAS) in the Mashi Conservancy in Namibia and Chobe Enclave Conservation Trust (CECT) in Bostwana, respectively. Permissions were obtained from different levels of governance, from national to local community levels. The objective was to link the UAS-collected aerial data with household survey data gathered alongside local partners, with the ultimate goal to determine biophysical impacts of various land and resource uses of communities throughout KAZA and how these align with ongoing efforts in the region.

Introductions and Demonstrations

Mabele Village (Botswana)

University of Namibia

Sachona Village (Namibia)



Flights and resource use areas in Mashi Conservancy, Namibia (2017).

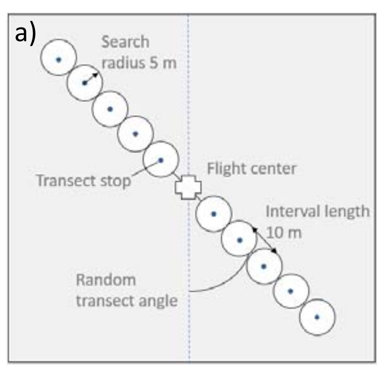
UAS Surveys

Mashi Conservancy, Namibia 2017

For each flight, a micro-UAS, outfitted with sophisticated sensors capable of detecting subtle changes in vegetation structure and productivity, was flown at 100-meter altitude and covered a 200 x 200-meter area for each flight (n=52).

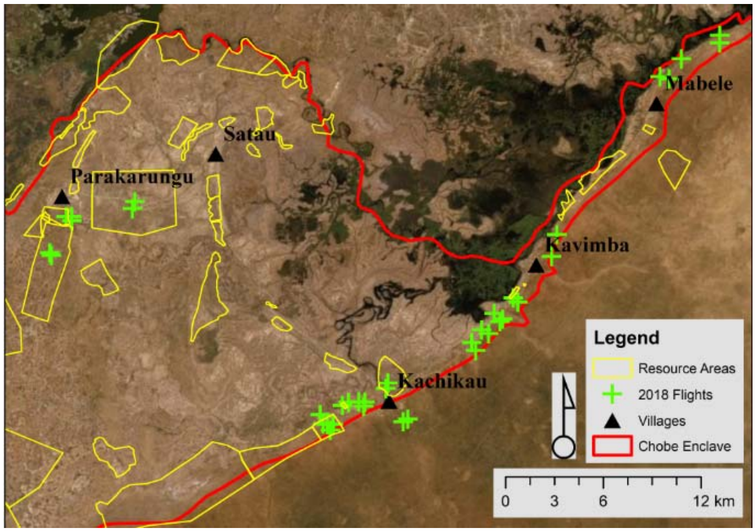
CECT, Botswana 2018

Flights in Botswana were conducted with an identical setup as in the Namibian field context and with a similar sampling approach (n=37). Nine sample sites, representing a gradient of savanna type, chosen for intensive field measurements to validate estimates derived from the processed UAS data.



a) Field sampling protocol for nine validation sites and the b) DJI Mavic Platform and Parrot Sequoia sensor flown for data collection.

Kavango-Zambezi Vulnerability and Adaptation

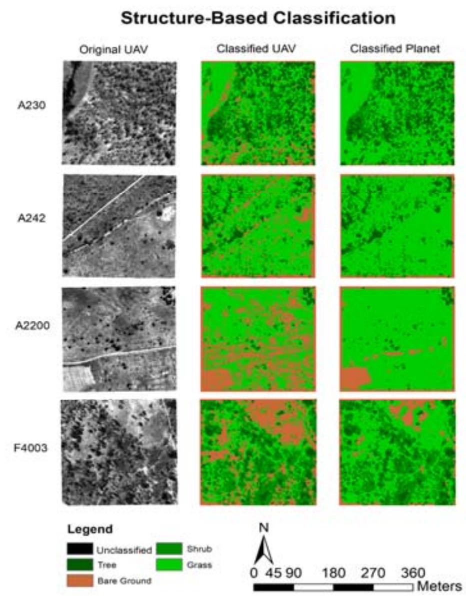


Flights with respect to villages in Chobe Enclave, Botswana (2018 field season).

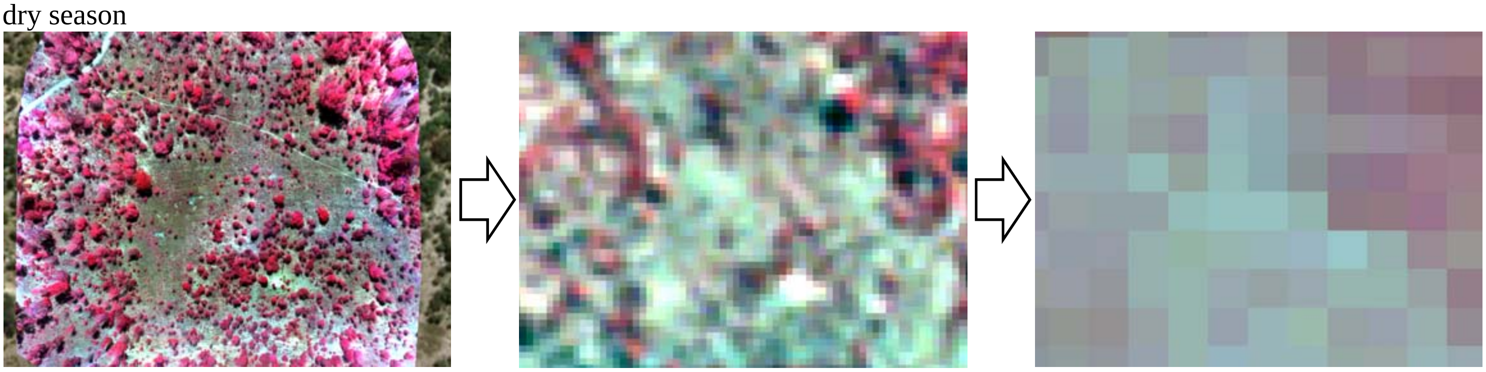
Next steps – Linking to Satellite Data

Making inferences about the magnitude and trajectory of land cover change requires time-series analysis. While the UAS surveys provide us with highly detailed data, these are only snapshots in time. Satellite remote sensing datasets, though with much coarser spatial resolutions, contain years and even decades of data. Linking observations of vegetation structure at the UAS scale (~10 cm) to those at the satellite scale (up to 30 m) could elucidate changes in vegetation structure throughout KAZA.

In the 3-panel figure below, we show how leveraging reflectance data beyond the visible portion of the spectrum can help to highlight various types of vegetation. In these false color composites, red pixels are indicative of healthy vegetation with active chlorophyll. We utilize the onset of the dry season to distinguish between grasses and woody vegetation when grasses are largely senesced and trees and bush remain productive. Though areas with woody vegetation are observable at all resolutions, it is difficult to distinguish between bush and tree cover in coarser satellite products. This distinction is important in terms of assessing the way the land functions and is one that only imagery at the UAS-scale can help to make. By creating maps that show fractional woody cover in terms of shrub extent at the UAS scale, we hope to establish statistical relationships between various amounts of tree and bush cover and coarse satellite products. Once established, past changes can be quantified and future changes estimated. These estimations can help guide decisions of policy-makers and farmers to mitigate the effects of environmental changes.



The structure-based classification shows an example of structure and productivity-based decision tree classification results using UAS and Planet satellite data (3m). In this method, PlanetScope generally underestimates low productivity values, while the UAV results remain noisy.



Examples of false color composites for UAS data (10 cm, left), RapidEye (5 m, center), and Landsat (30 m, right)

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