African Lidar and Spectral Imaging Activities

150th Anniversary of French Physical Society, 4th July 2023, Paris

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norsk elektro optikk

LUNDS UNIVERSITET


Bamako, Mali 2011

Article

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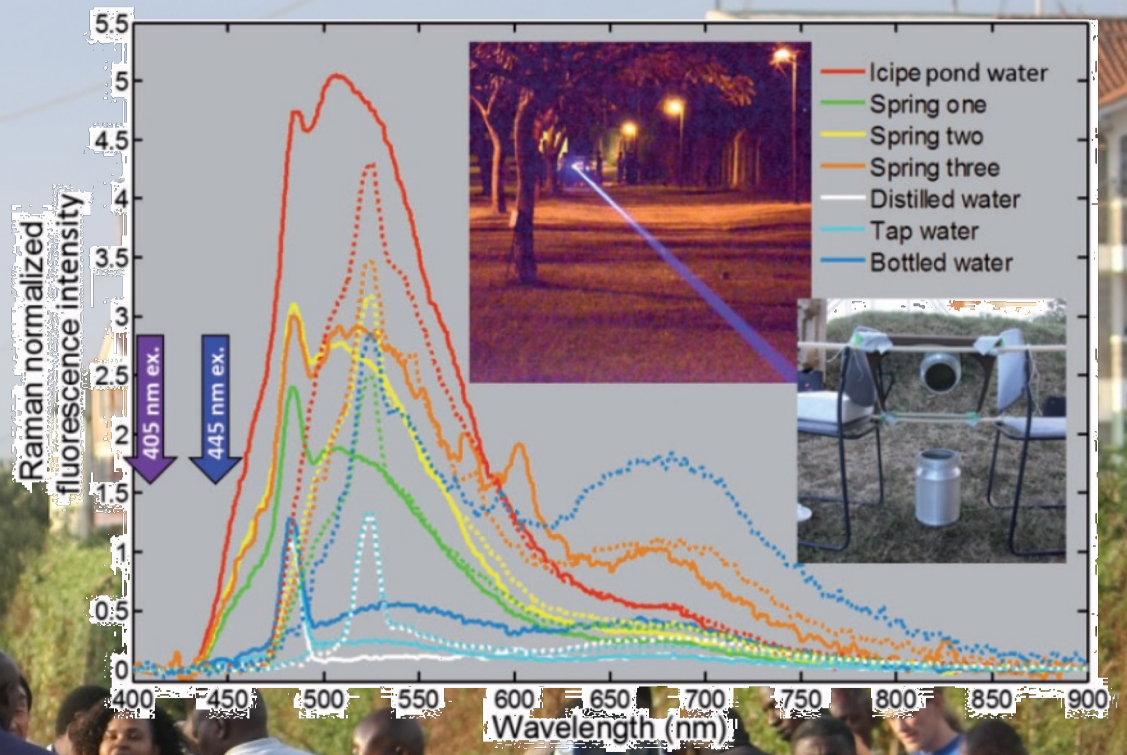
SAGE

Realistic Instrumentation Platform for Active and Passive Optical Remote Sensing

Mikkel Brydegaard[1,2,3,*], Aboma Merdasa[1], Alem Gebru[1,2], Hiran Jayaweera[1,4], and Sune Svanberg[1,5]



Nairobi, Kenya 2012

Time-Of-Flight components

Scheimpflug components

Lidar made 100 times funkier

PMT

HV

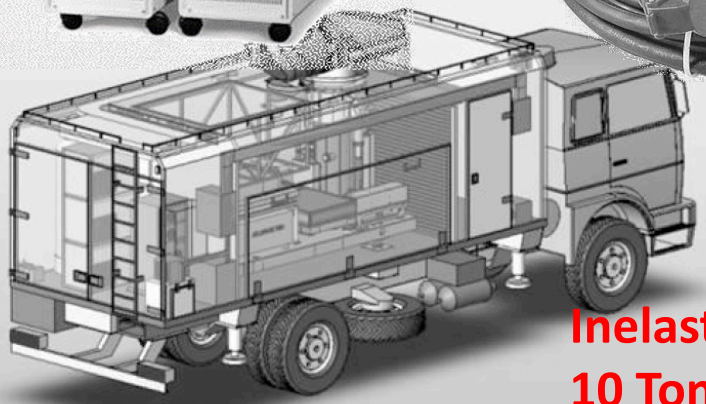
H_2O

RF

Nd:YAG

N_2

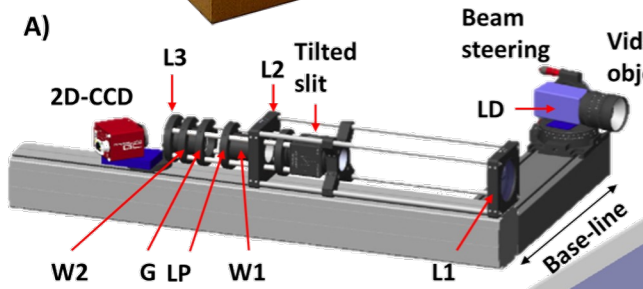
Power



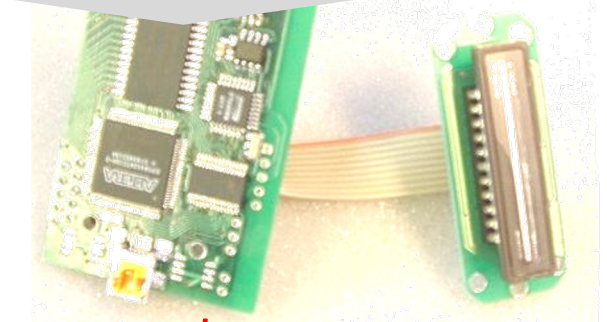
Inelastic lidar 2008
10 Tons, 4M$, 1W,
20 Hz, 4 ch

Inelastic lidar 2018
1 kg, 3k$, 3W,
200 Hz, 64 ch

10W, 2g, 100$

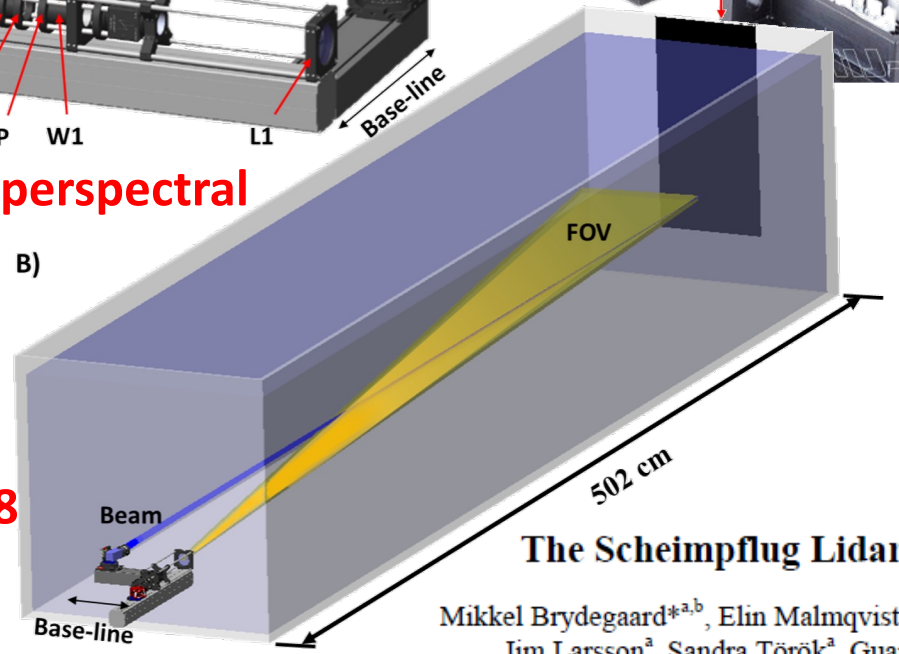


Hyperspectral



7kHz, 1000$

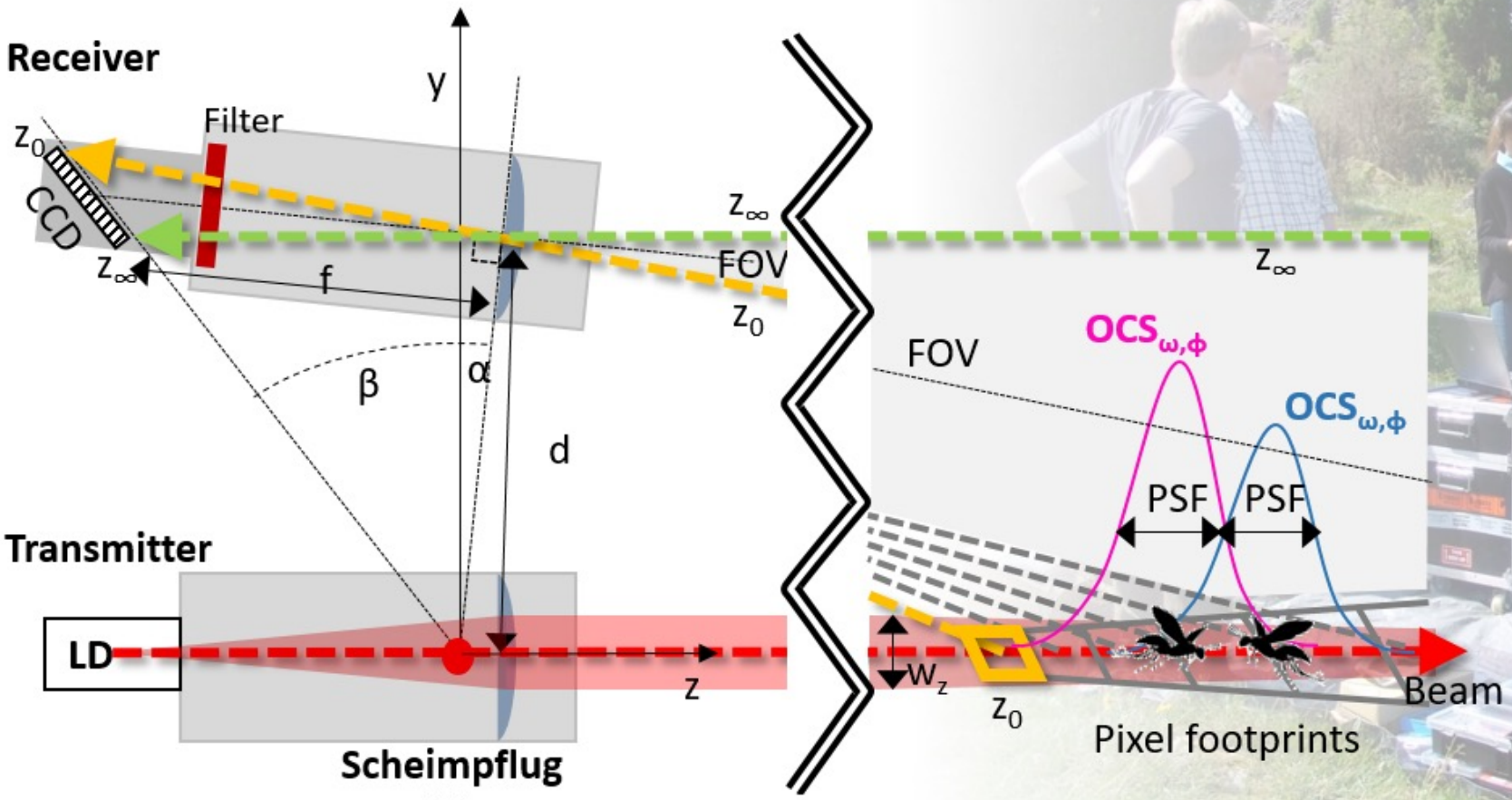
3W, 50$



The Scheimpflug Lidar Method

Mikkel Brydegaard*[a,b], Elin Malmqvist[a], Samuel Jansson[a], Jim Larsson[a], Sandra Török[a], Guangyu Zhao[a,b,c]

Scheimpflug lidar method and instrument: Infinite focal depth with large aperture.

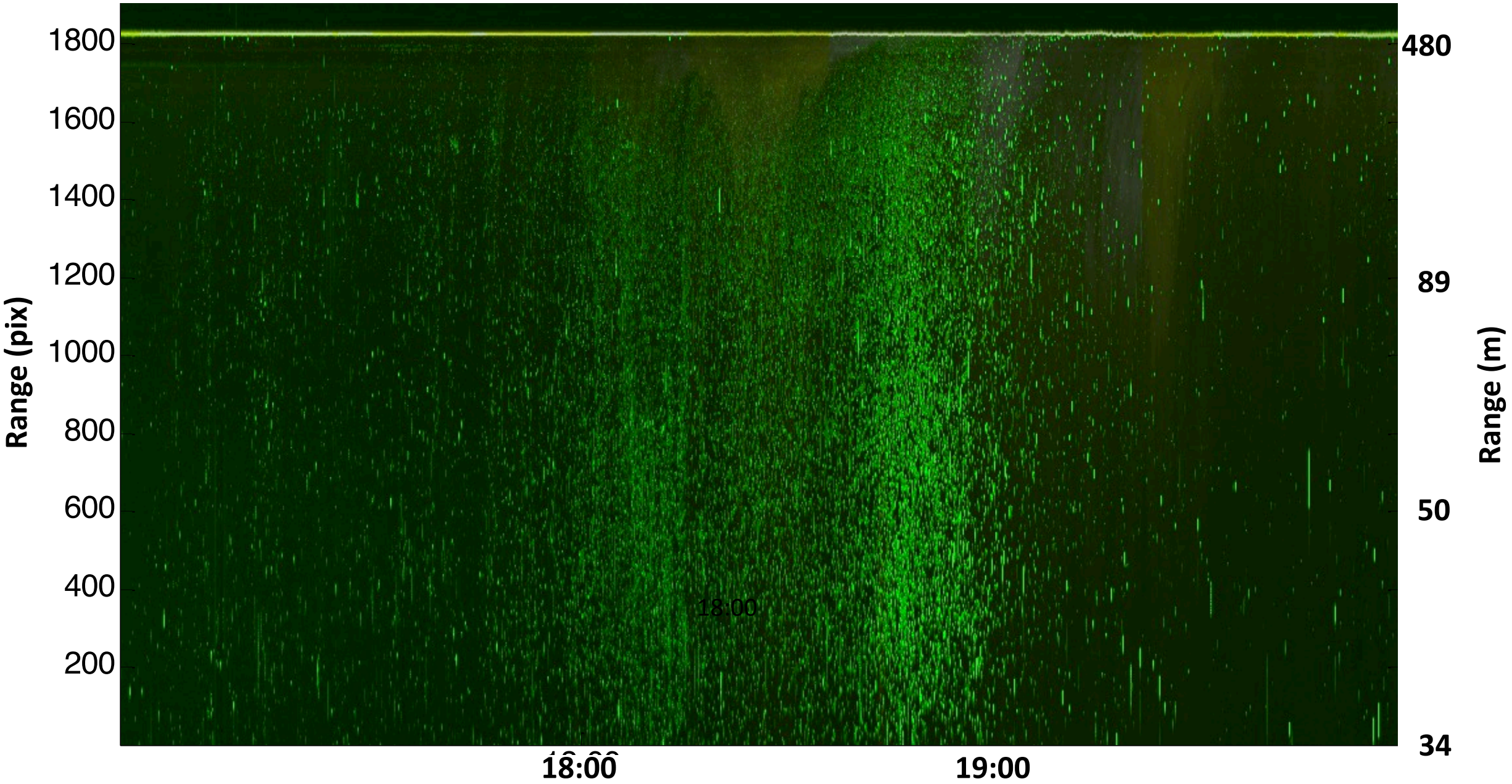


Brydegaard, M., Gebru, A. & Svanberg, S., "Super resolution laser radar with blinking atmospheric particles – application to interacting flying insects " *Progress In Electromagnetics Research,* Vol. 147, 141-151, 2014

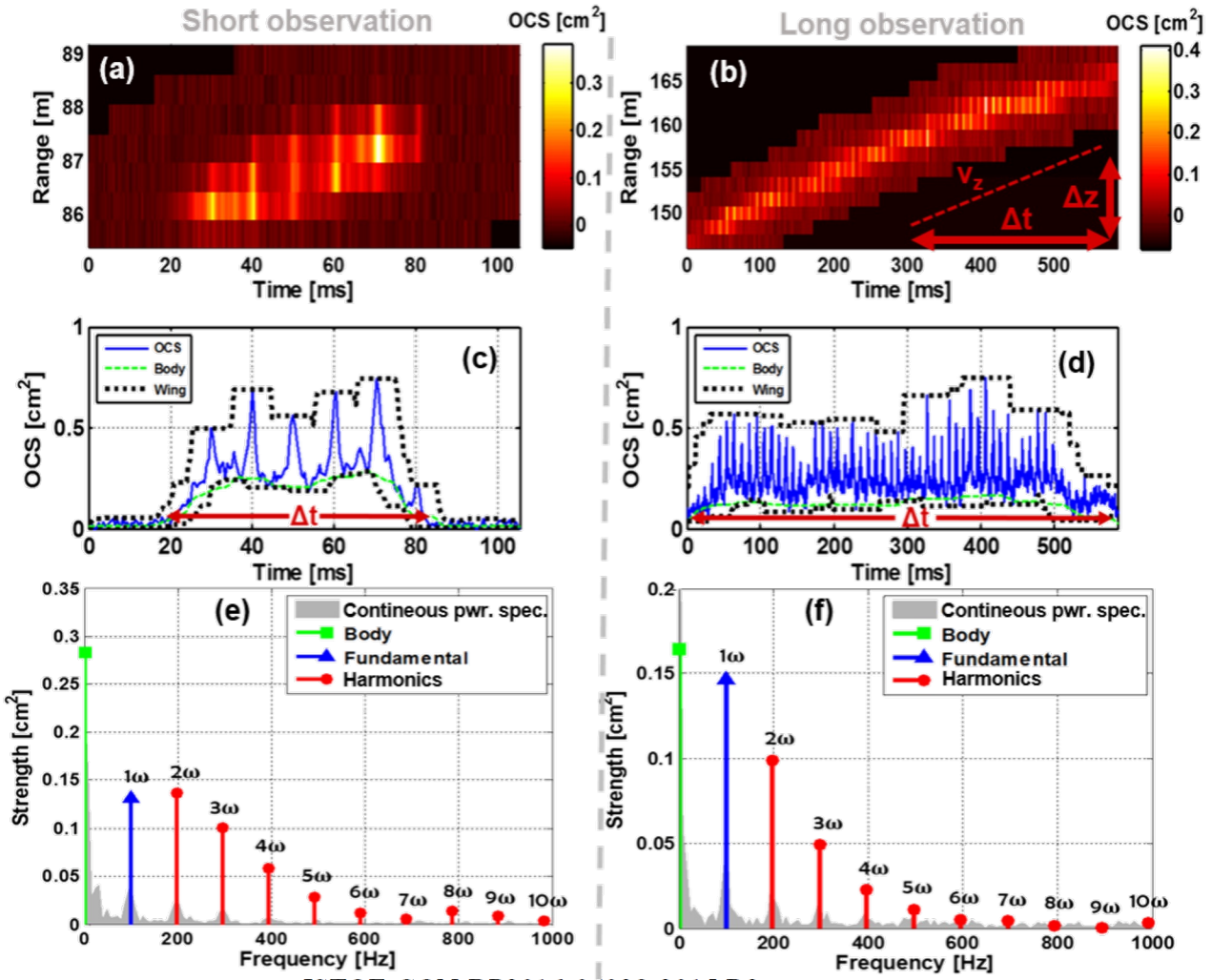
Made in Africa

Infrared photograph, Tanzania 2016

Malaria mosquito rush-hour in Tanzania 25.000 Observations/Hour



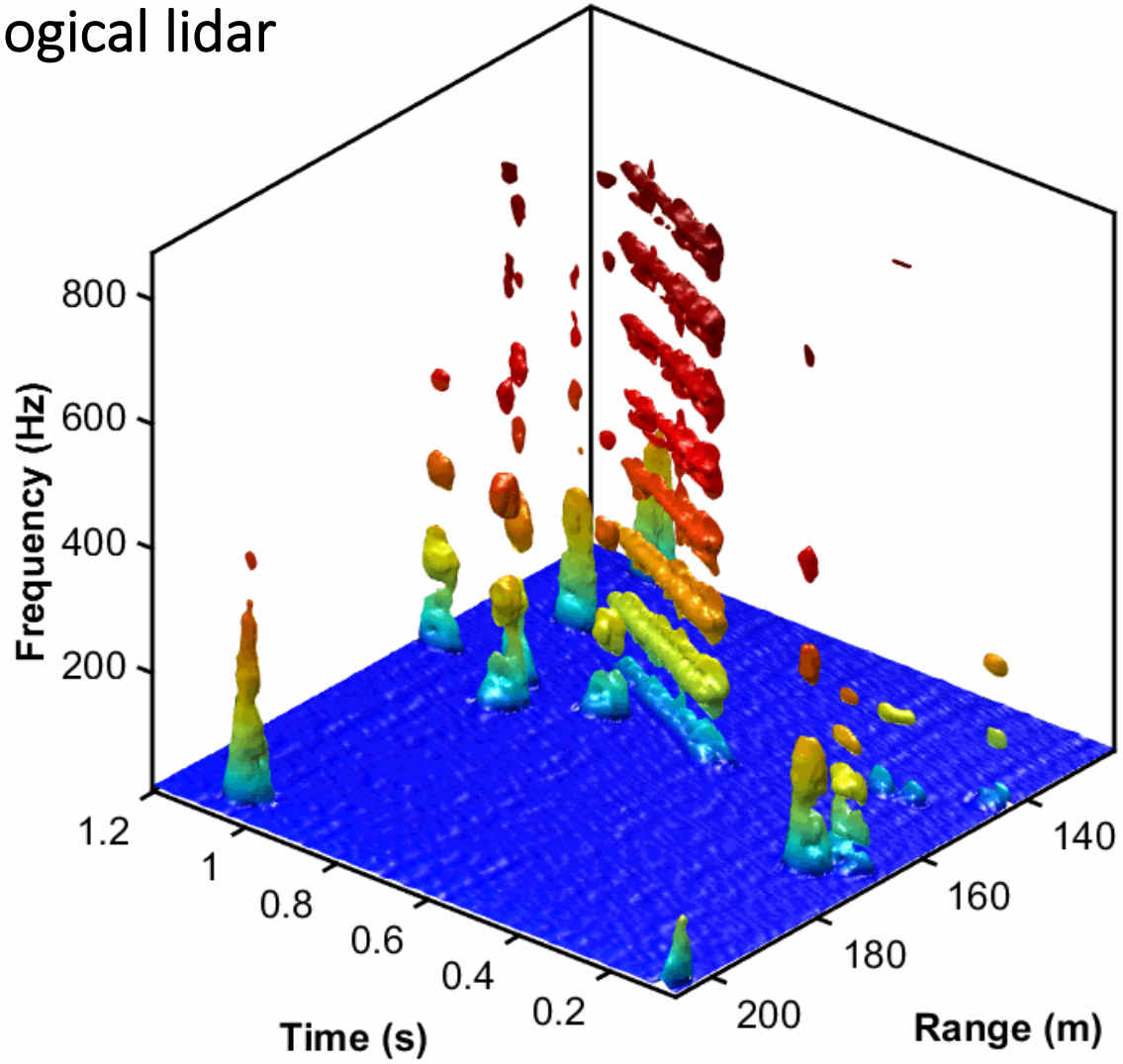
Measuring atmospheric backscatter thousands of times per second
Remote modulation spectroscopy with kHz entomological lidar



JSTQE-CON-BP2016-06038-2015.R2

Effective parameterization of laser radar observations of atmospheric fauna

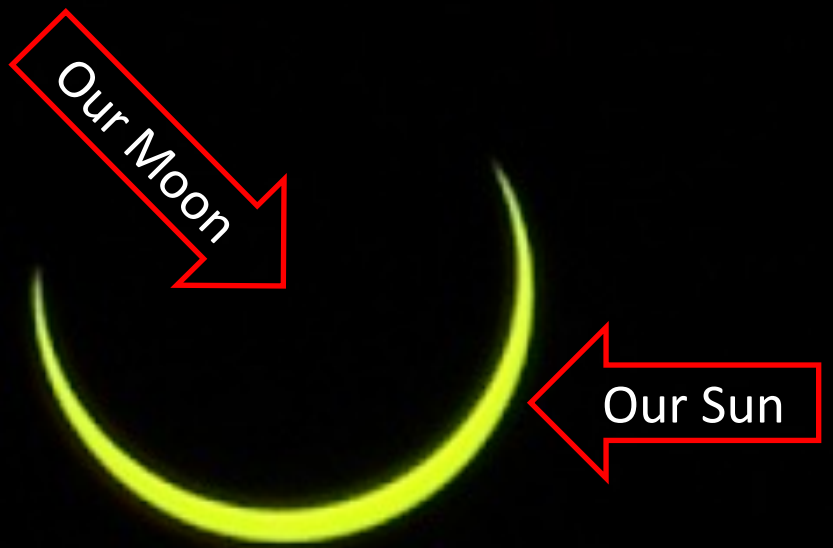
E. Malmqvist, S. Jansson, S.Török, M. Brydegaard



Towards Quantitative Optical Cross Sections in Entomological Laser Radar – Potential of Temporal and Spherical Parameterizations for Identifying Atmospheric Fauna

Mikkel Brydegaard[1,2,3]*

Annular eclipse, 1 Sep. Tanzania 2016



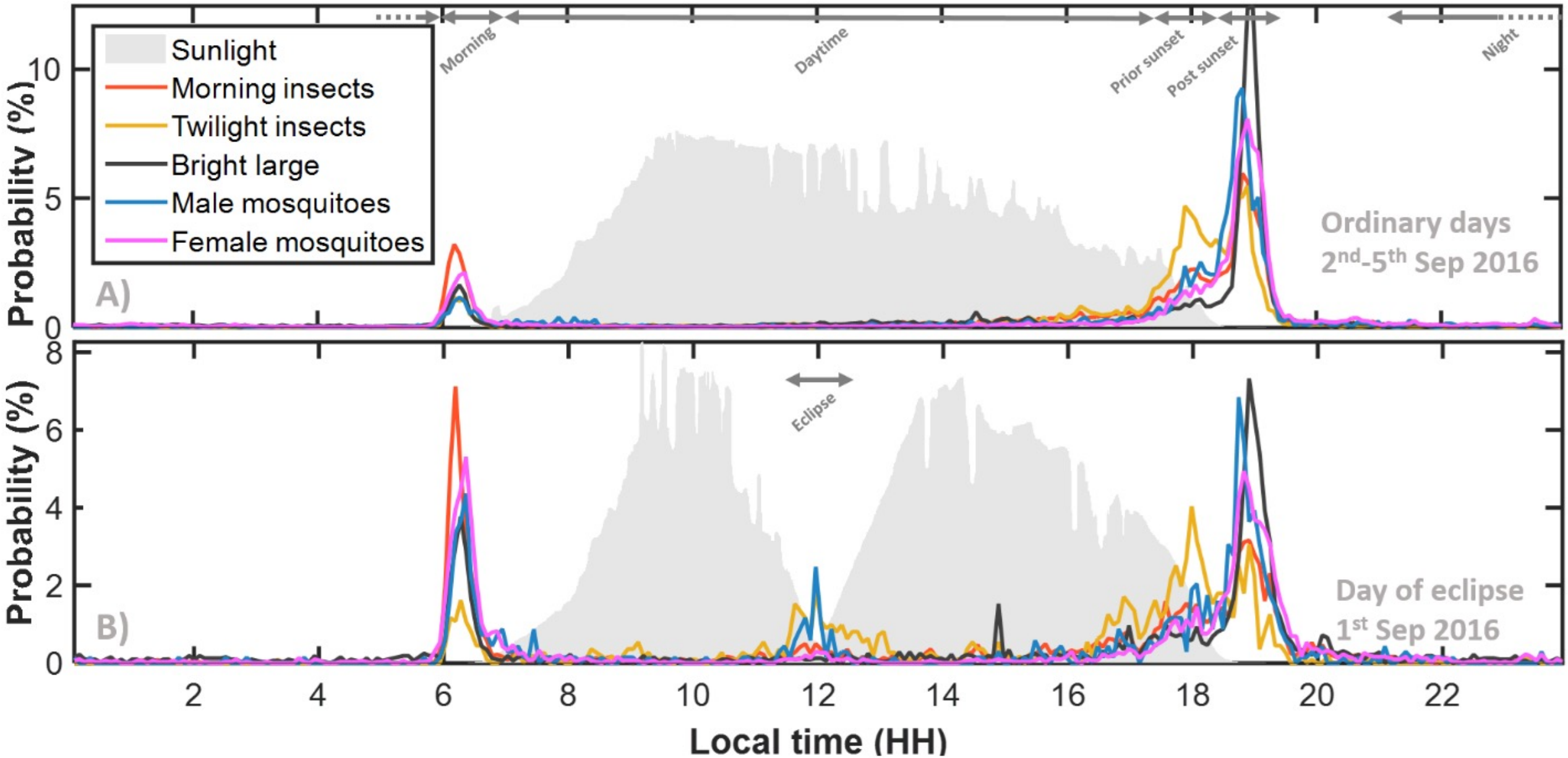
SCIENCE ADVANCES | RESEARCH ARTICLE

ECOLOGY

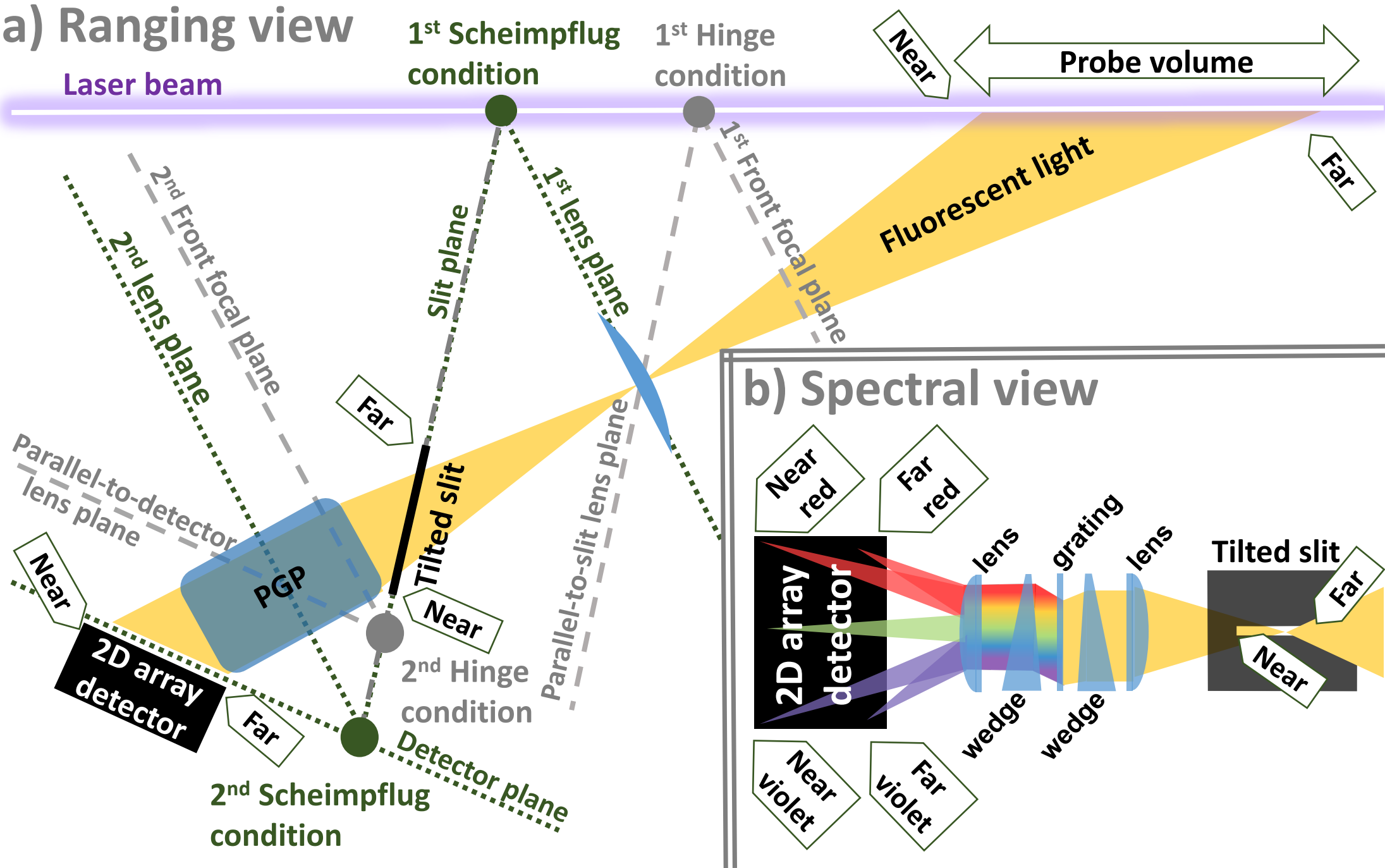
Lidar reveals activity anomaly of malaria vectors during pan-African eclipse

Mikkel Brydegaard[1,2,3,4]*, Samuel Jansson[2,3], Elin Malmqvist[2,3], Yeromin P. Mlacha[5,6,7], Alem Gebru[2,3,4], Fredros Okumu[5,8,9], Gerry F. Killeen[5,10,11], Carsten Kirkeby[4,12]*

Are mosquitoes active during eclipses?

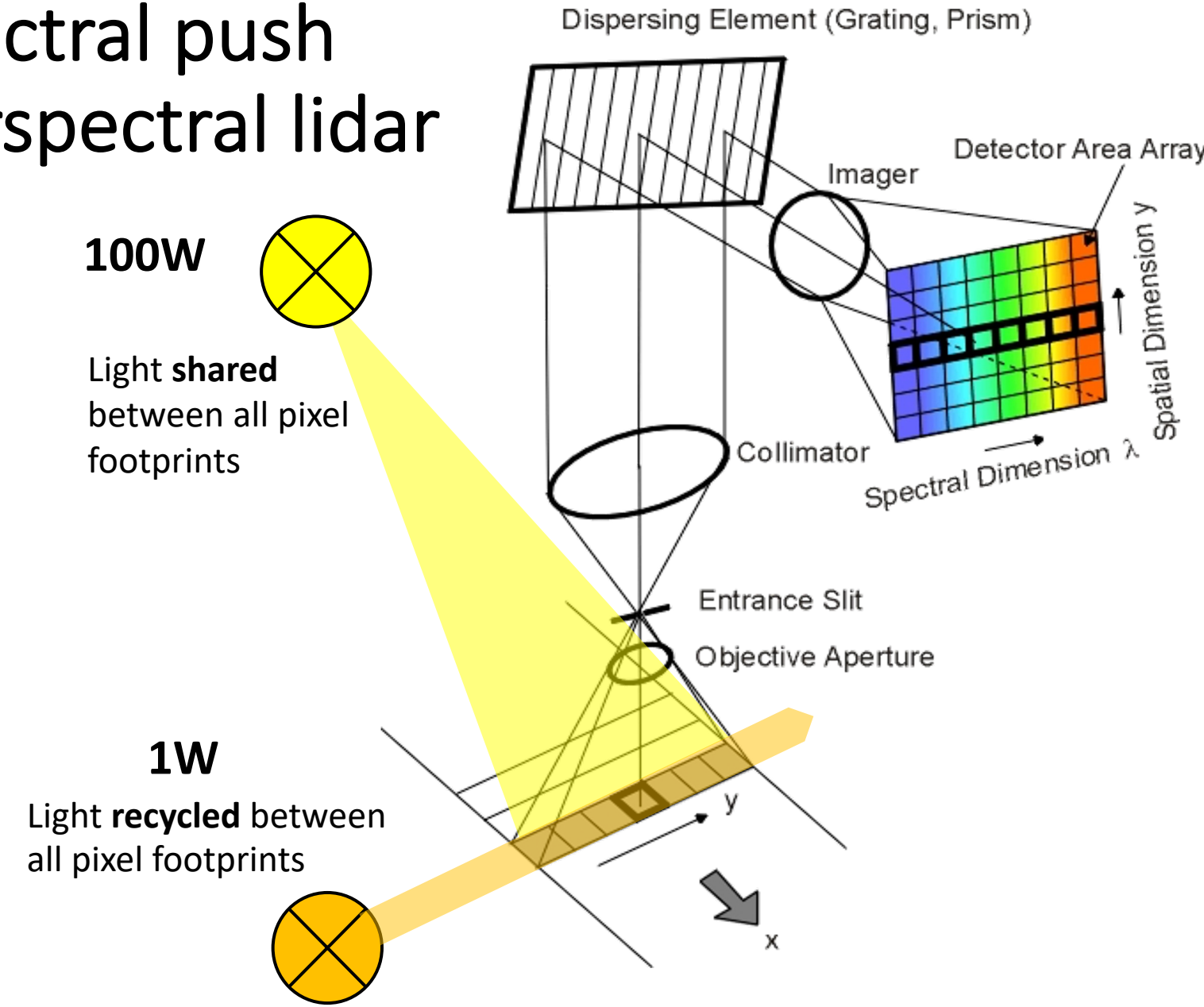


Hyperspectral lidar with 2D imagers

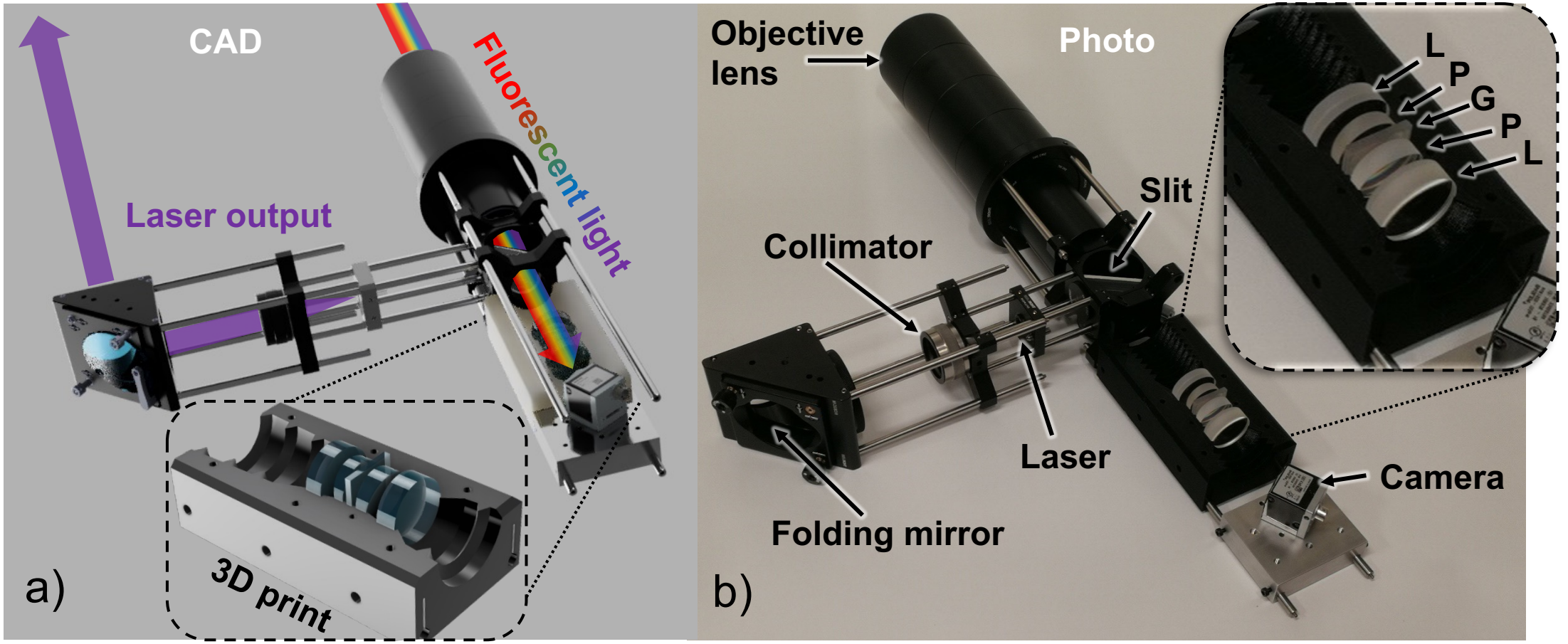


Recycling light and efficiency of illumination in hyperspectral push broom imaging vs hyperspectral lidar

- In push broom P/N_{pix} transilluminate each pixel footprint
- In hyperspectral lidar P transilluminate all pixel foot prints
- The increase efficiency can be used for:
  - kHz sample rates
  - Very low reflectances (e.g. clean air)
  - Weak interactions such as fluorescence



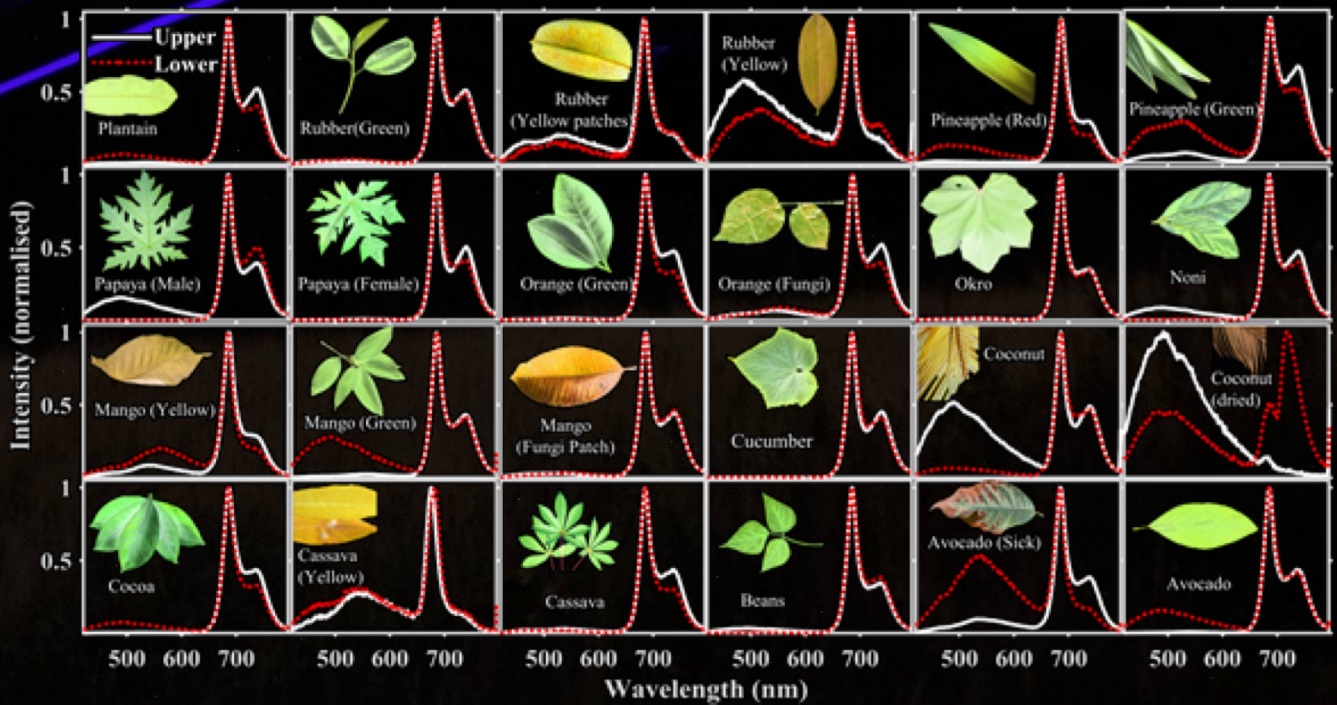
Rapid prototyping with 3D printed sandwich architecture
1 week from Raytracing to physical prototype



Range: 3-100 m, Spectral range: 400-800 nm, 70 effective bands, Power: 1W@405nm, Speed: 120 Hz, Weight: 2 Kgs, total material cost: 3 kEur

Hyperspectral 3D scanning of vegetation structure

Spectra from local crops, Cape Coast, Ghana

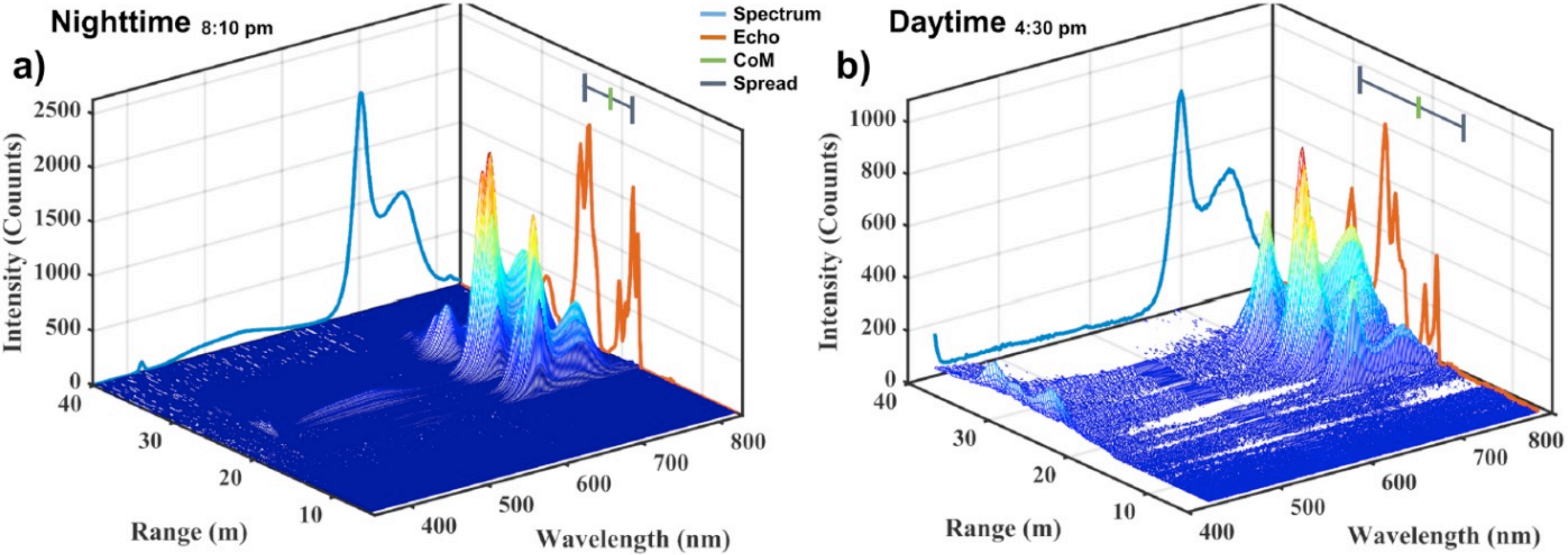


IEEE JOURNAL OF SELECTED TOPICS IN QUANTUM ELECTRONICS, VOL. 29, NO. 4, JULY/AUGUST 2023 7100607

Remote Vegetation Diagnostics in Ghana with a Hyperspectral Fluorescence Lidar

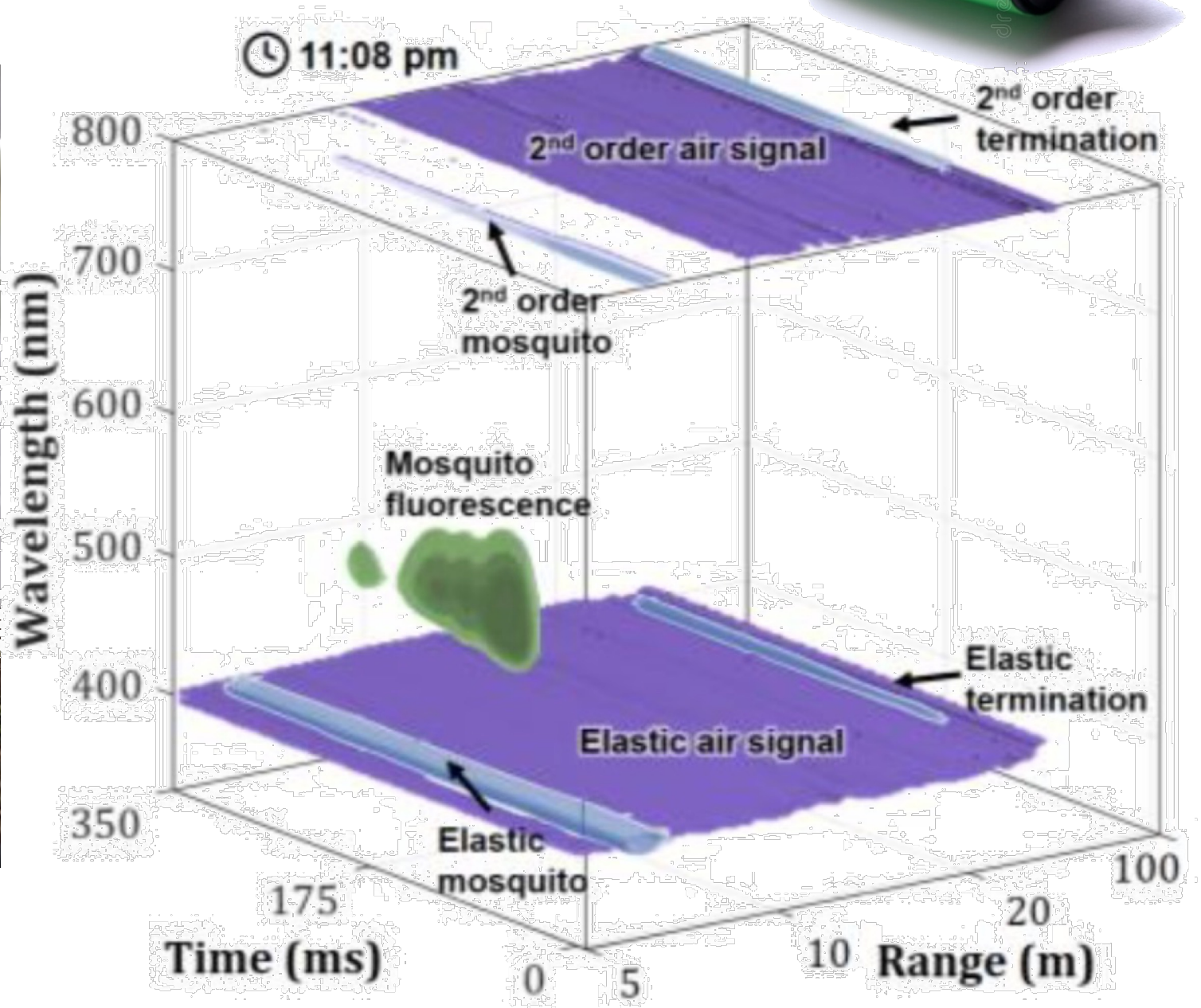
Rabbi Boateng, Andrew Atiogbe Huzortey, Yatana Adolphe Gbogbo, Assoumou saint-doria Yamoa, Jérémie T. Zoueu, Mikkel Brydegaard, Benjamin Anderson, and Hampus Månefjord

Fluorescent hyperspectral scanning of vegetation structure in day light.

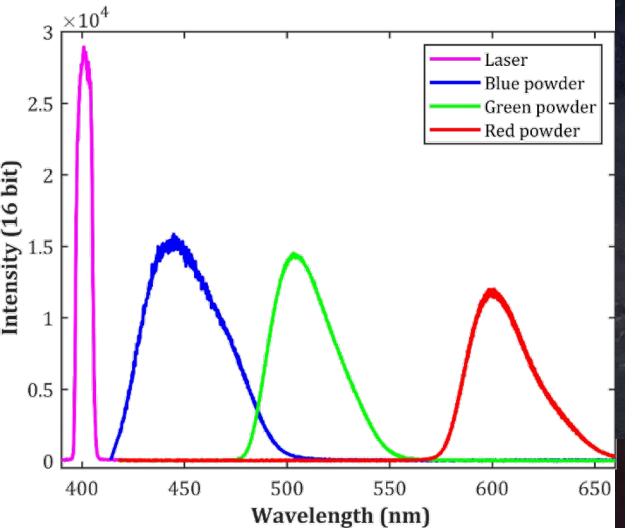


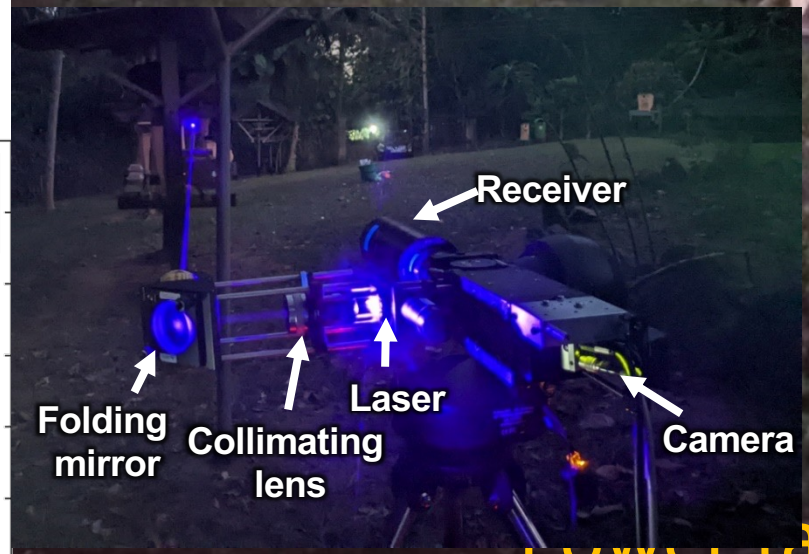
Cape Coast, Ghana 2022

Tagging by nectar source and fluoresce highlight pen



Do different species display distinct daily activity pattern?

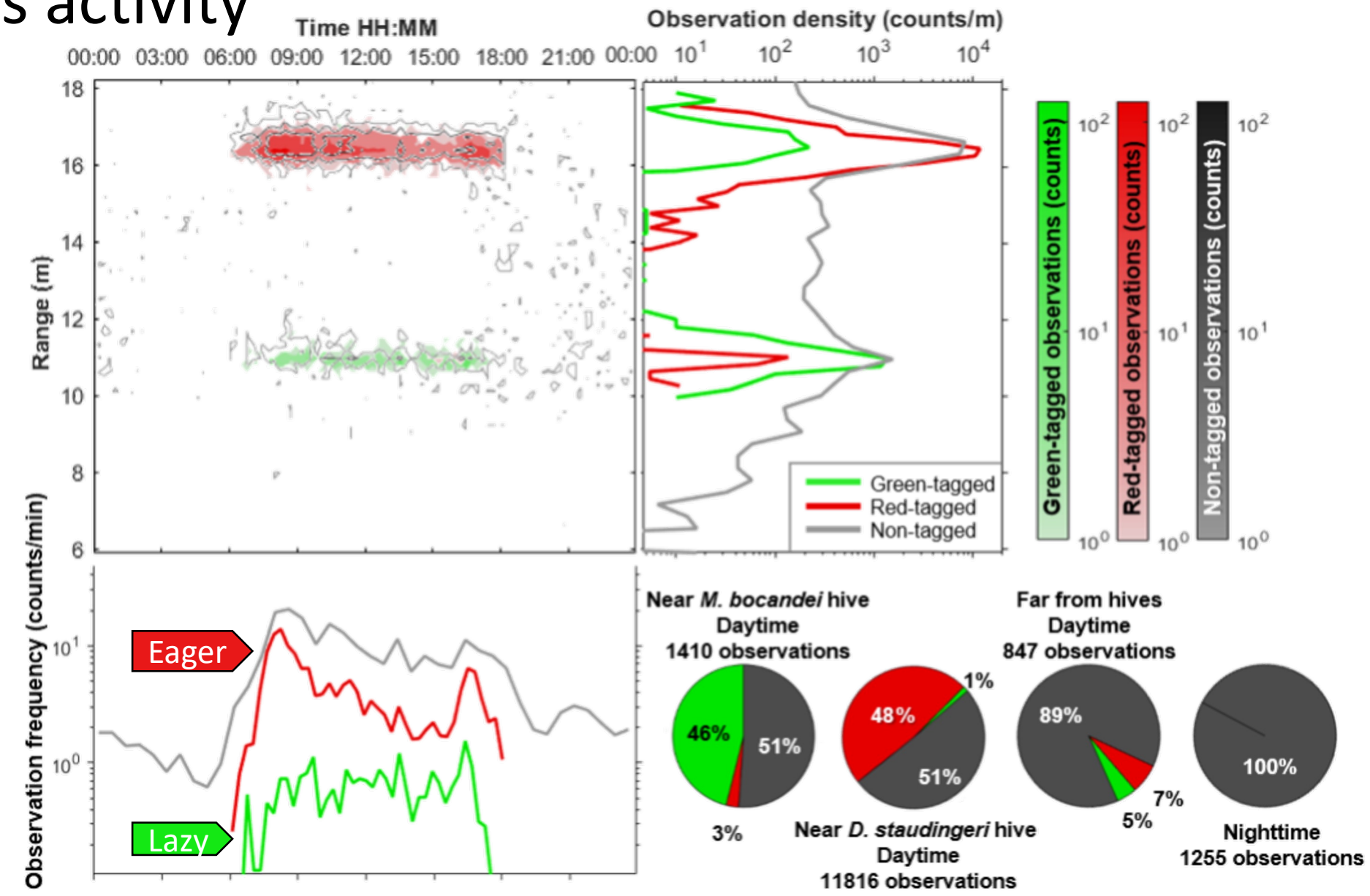




Power tagging stingless bees, Ghana 2022

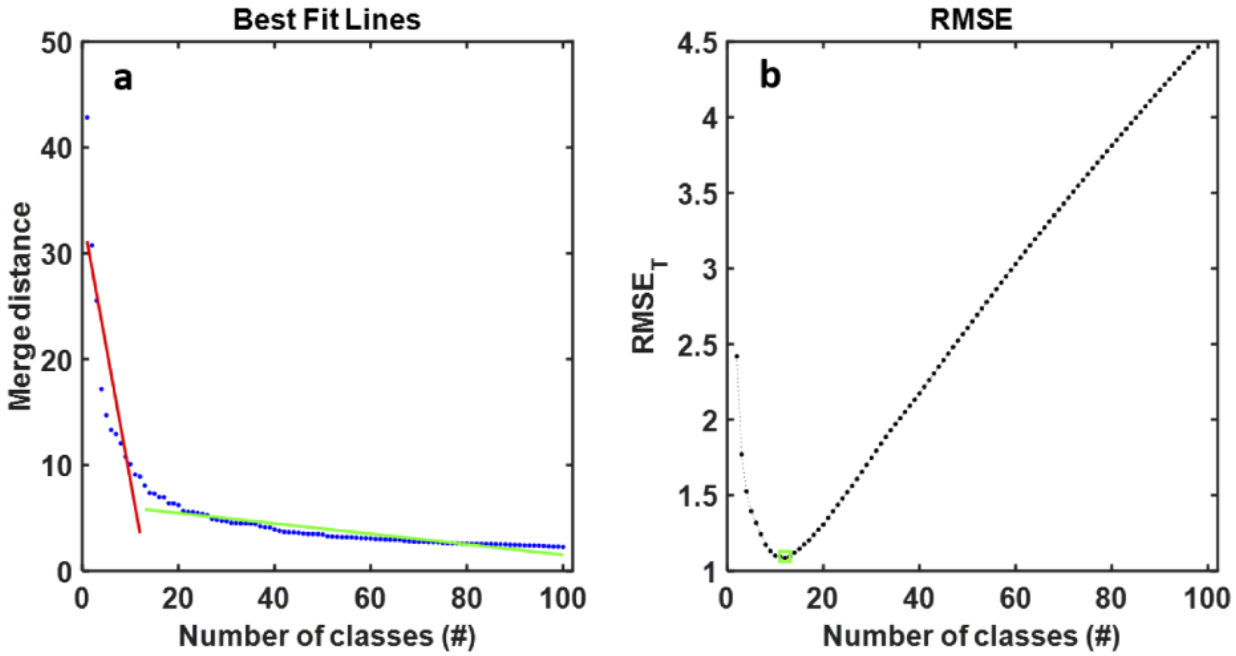
Quantitative assessment of distinct species activity patterns

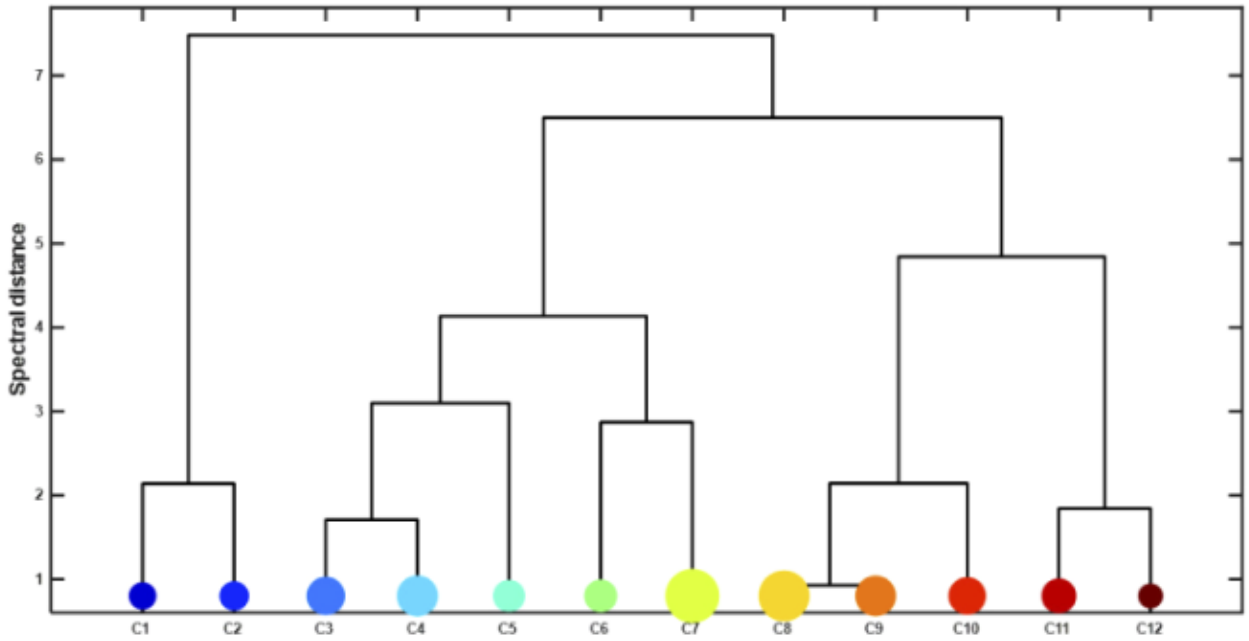
Obs: Daytime fluorescence lidar!



Measuring species richness *in situ*

- Sometimes we don't need to know what is detected, we simply want to know the number of species present in a dataset
- Elbow test, Information criteria, Silhouette, Calinski Harabasz, Davies Bouldin

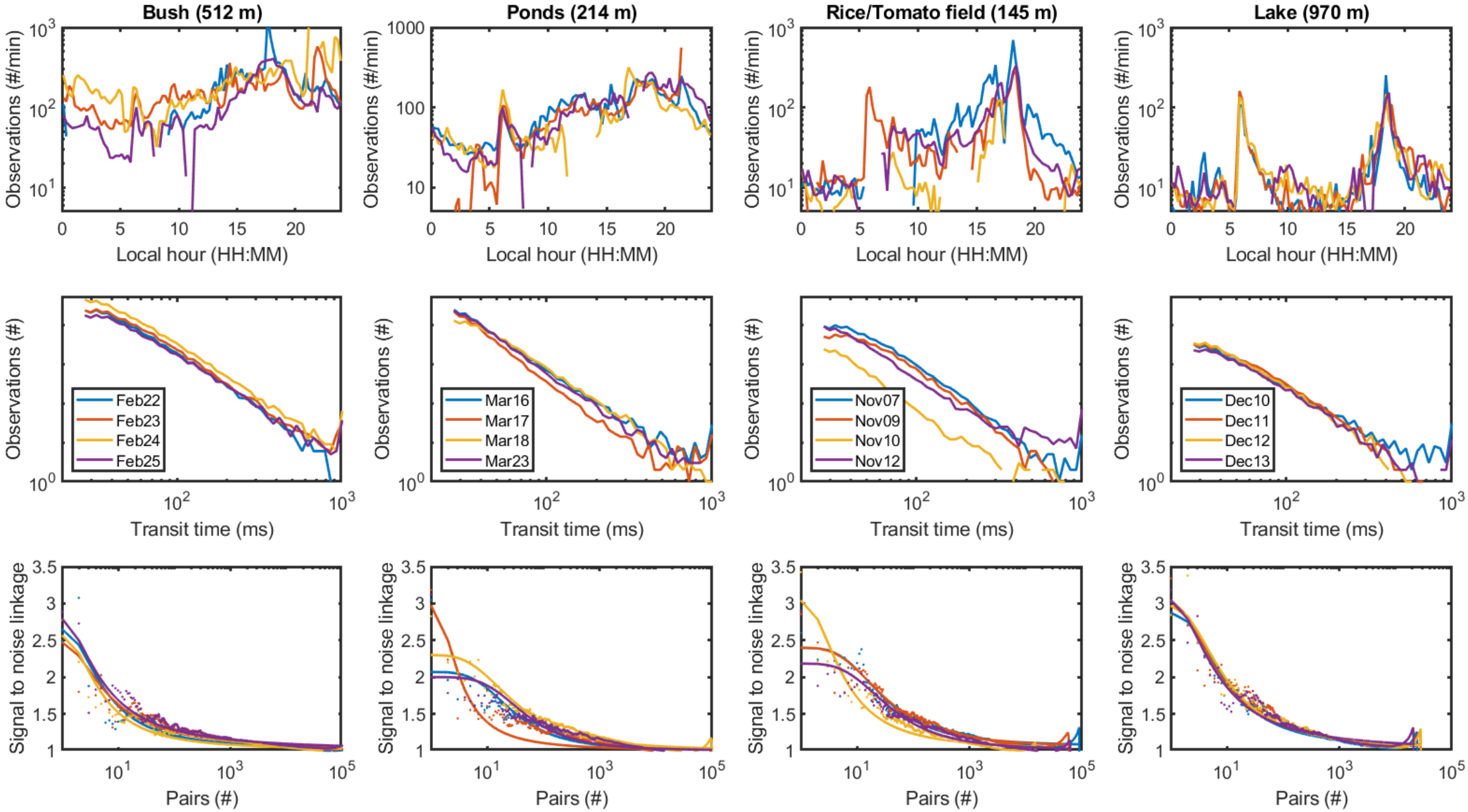




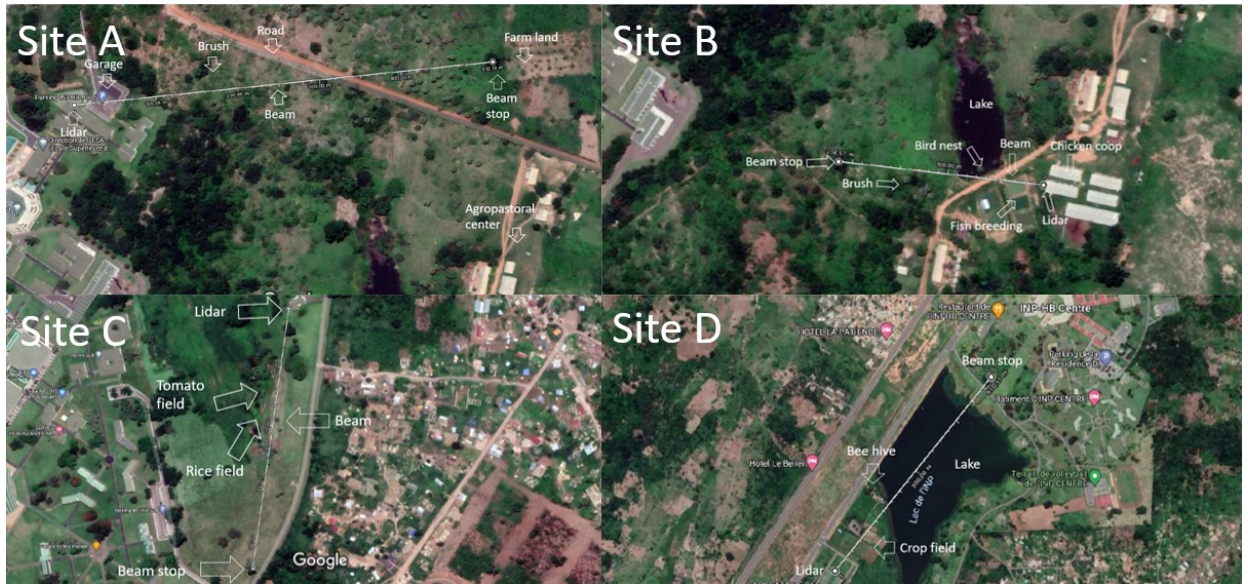
Entomological Scheimpflug lidar for estimating unique insect classes *in-situ* field test from Ivory Coast

BENOIT K. KOUAKOU,[1,*] SAMUEL JANSSON,[2,3] MIKKEL BRYDEGAARD,[2,3] AND JEREMIE T. ZOUEU[1]

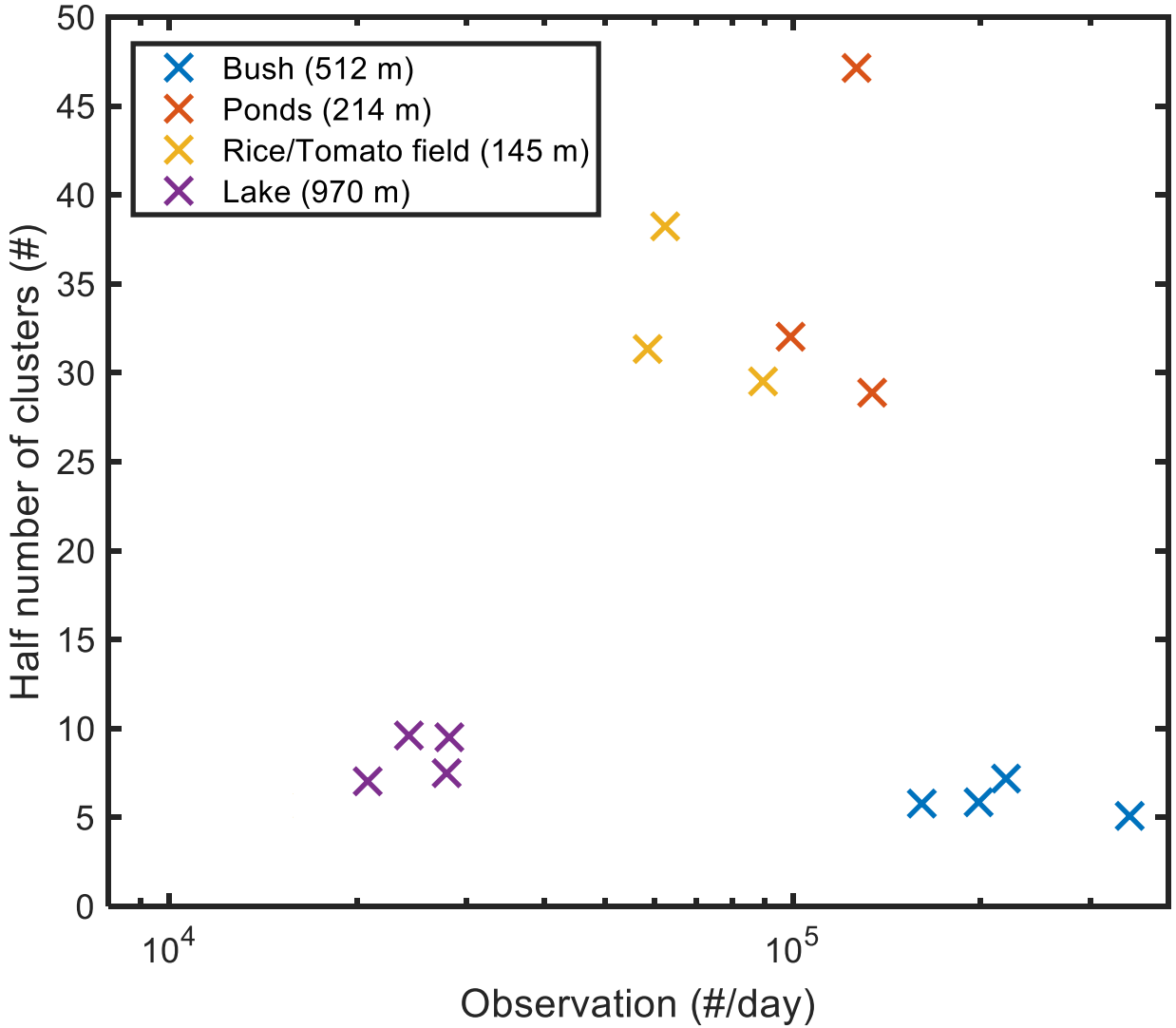
Comparative study at four Ivorian sites



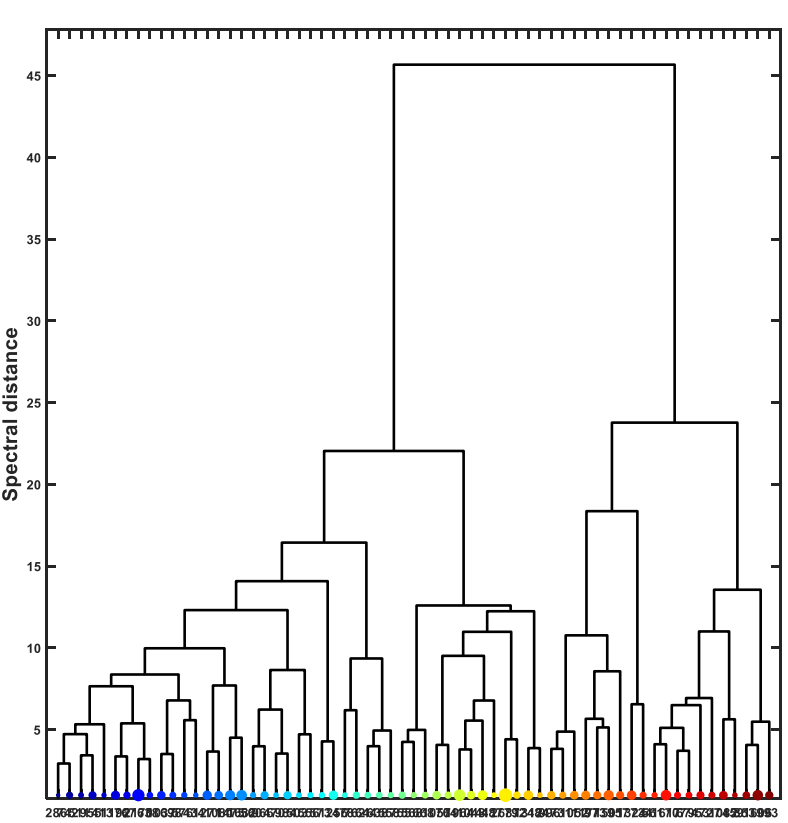
Comparative lidar assessment of richness at 4 sites

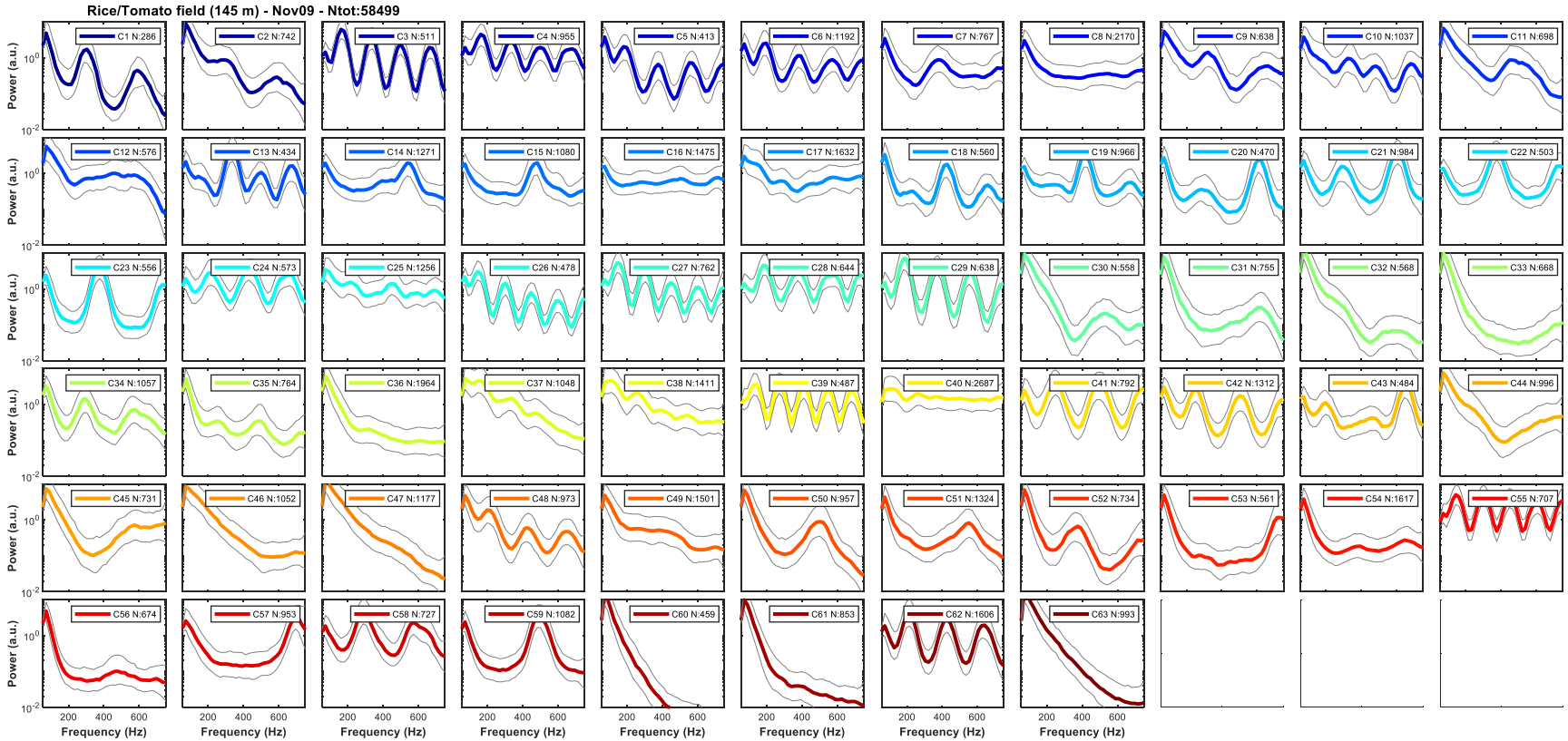


- ✓Day-to-day assessment are consistent
- ✓Sites show distinct richness and abundance
- ✓Richness is not necessarily increasing with abundance

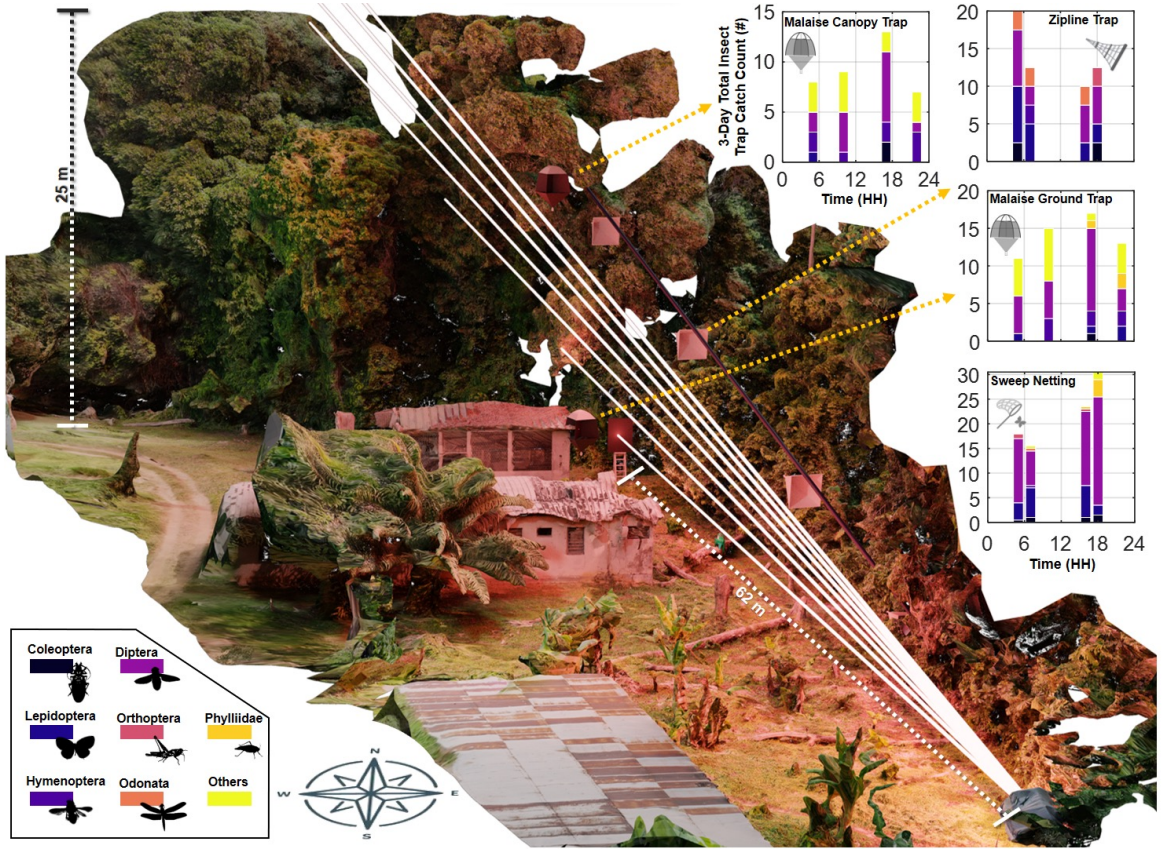


Example of signal diversity at rich site (58.499 observations - 63 clusters)

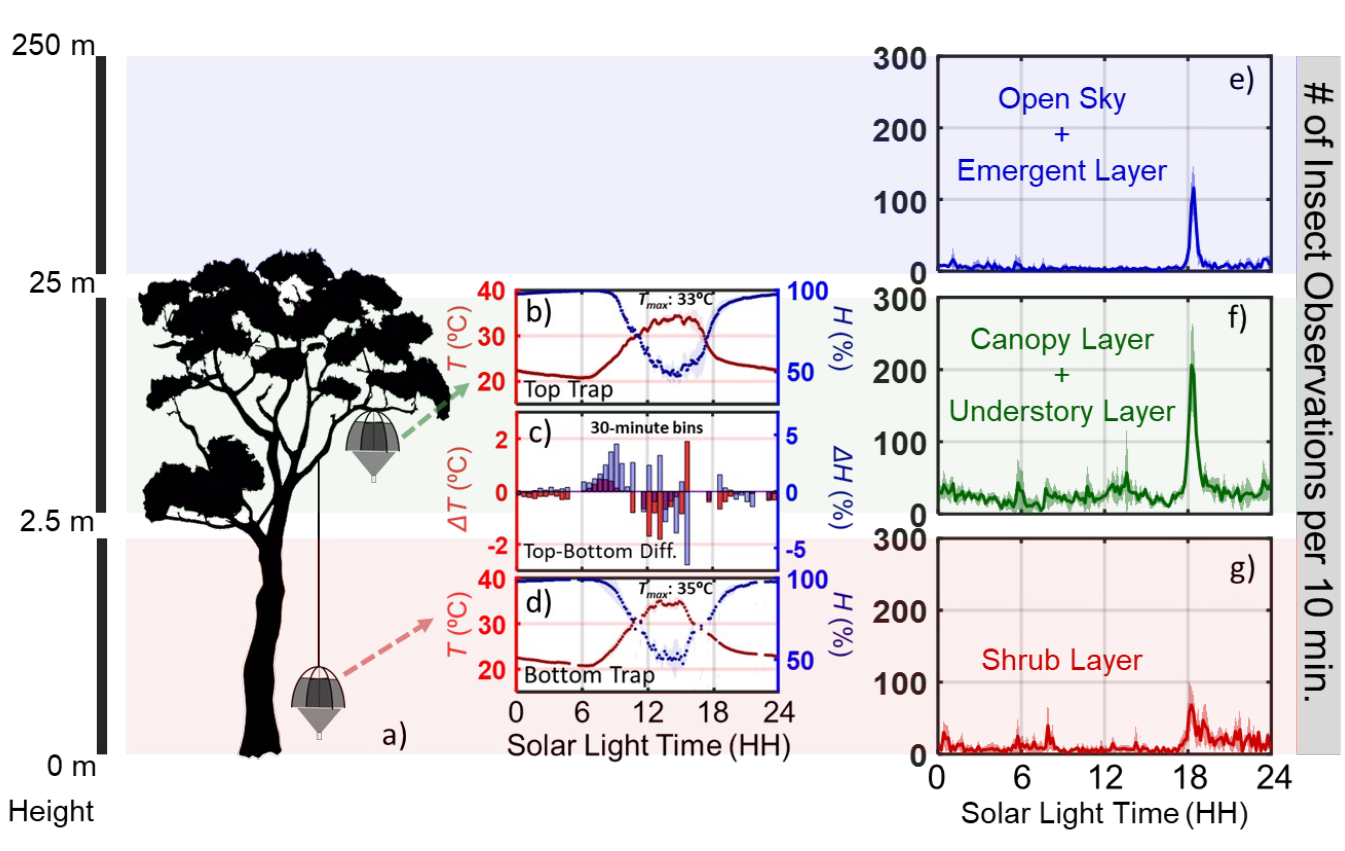




Assessment of diversity and diurnal activity patterns in the Ivorian virgin forest Taï

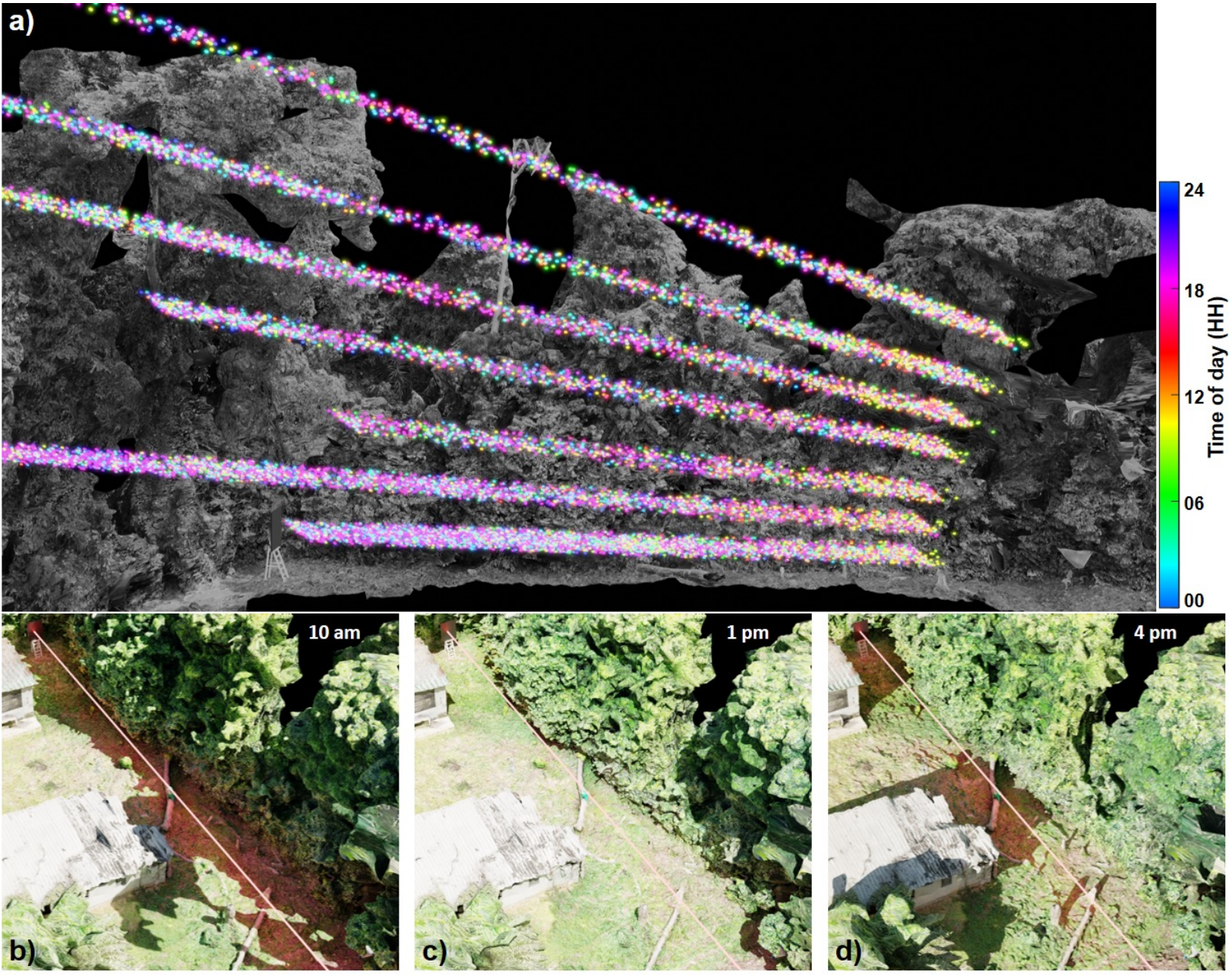


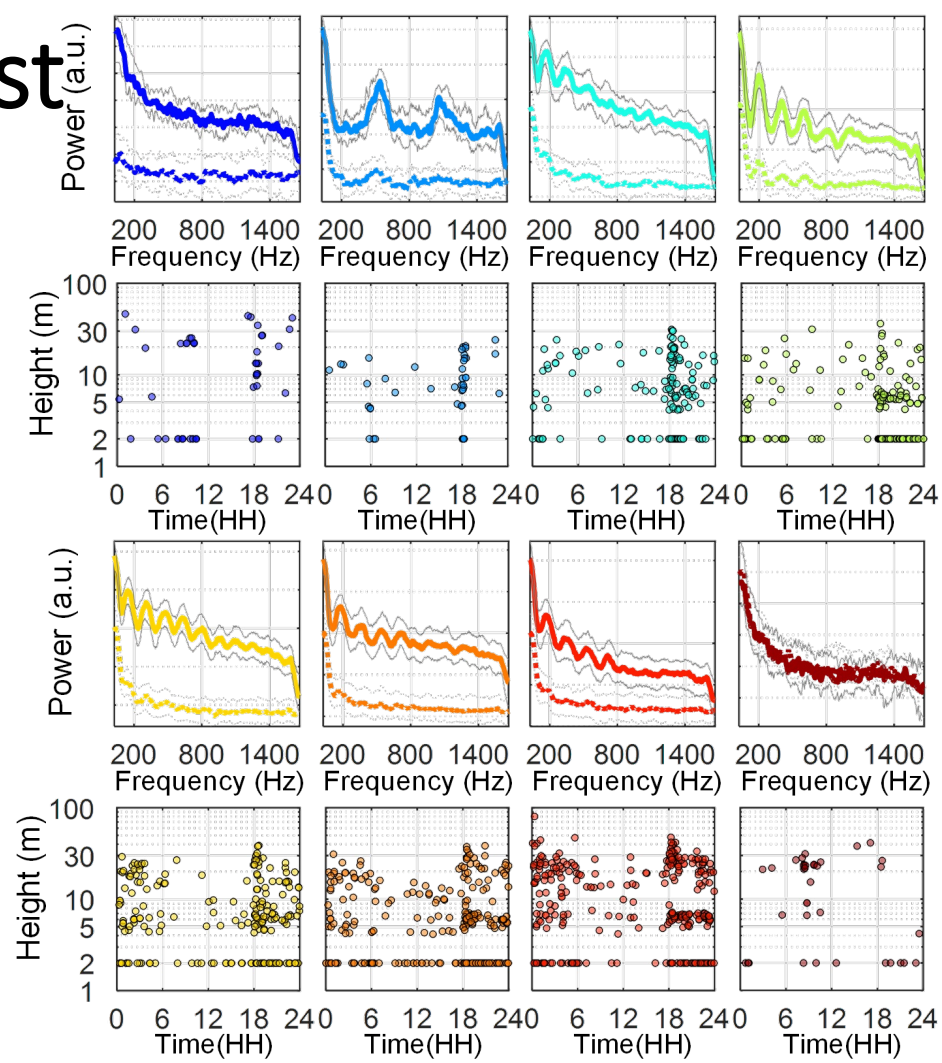
Automated elevation scanning



Taï virgin forest, Ivory Coast 2023

Initial results for Taï Ivorian virgin forest



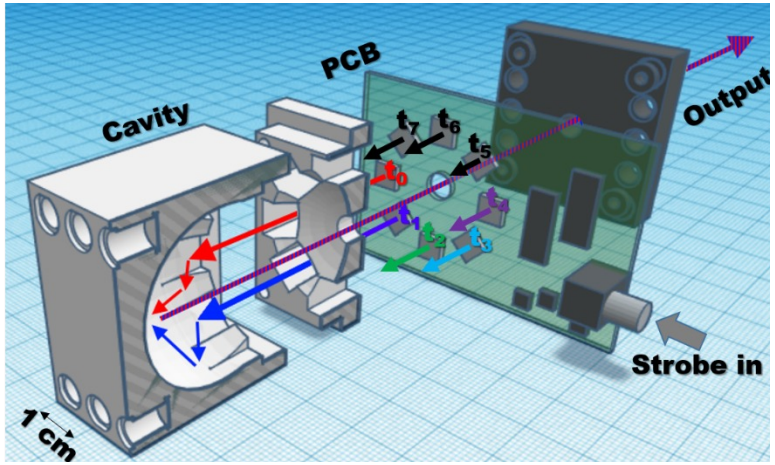


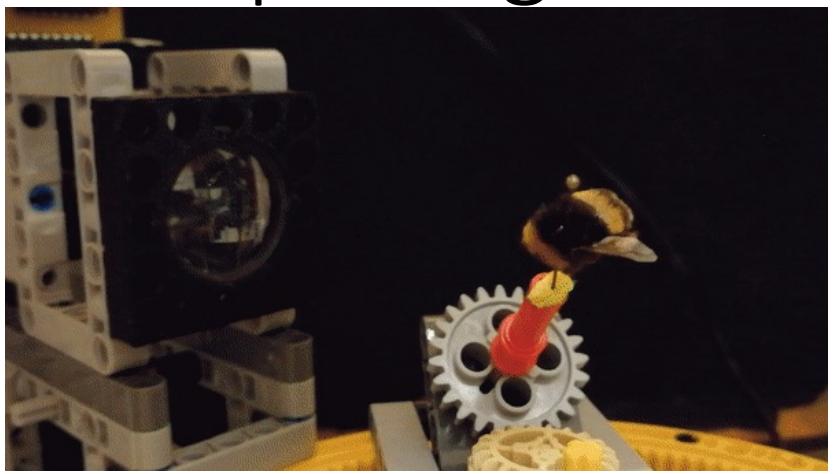
Title: Exploring Insect Stratification & Diversity Across Taï Forest Canopy, Côte d'Ivoire

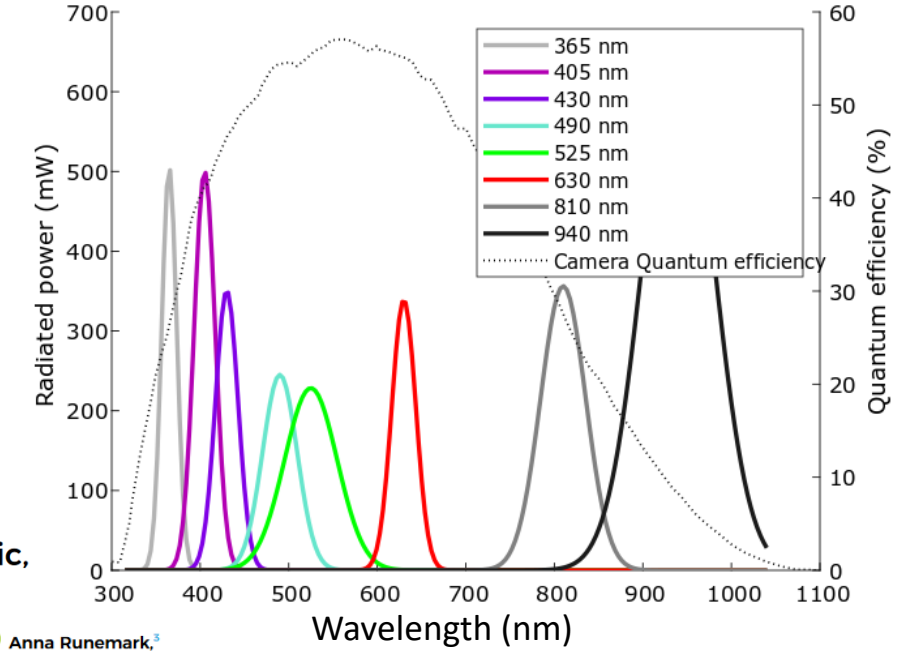
Authors: Hampus Månefjord[1*], Assoumou saint-doria Yamoa[2], Yatana Adolphe Gbogbo[2], Lauro Müller[1], Anna Runemark[3], Benoit Kouassi Kouakou[4], Rabbi Boateng[5], Andrew Atiogbe Huzortey[5], Mikkel Brydegaard[1,2,6,7], Jérémie T. Zoueu[4], Benjamin Anderson[5], Meng Li[1]

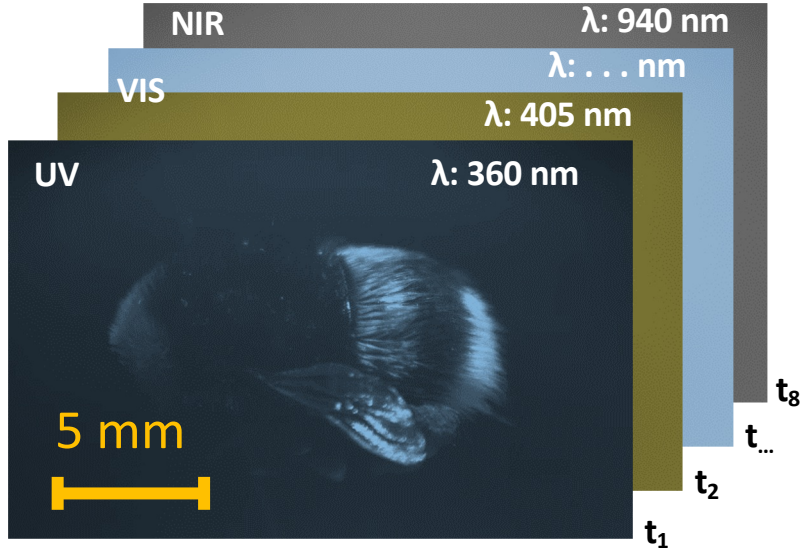
Ivory Coast, 2023

Characterisation of light scattering from biological targets. Multispectral imaging by LED multiplexing









A biophotonic platform for quantitative analysis in the spatial, spectral, polarimetric, and goniometric domains

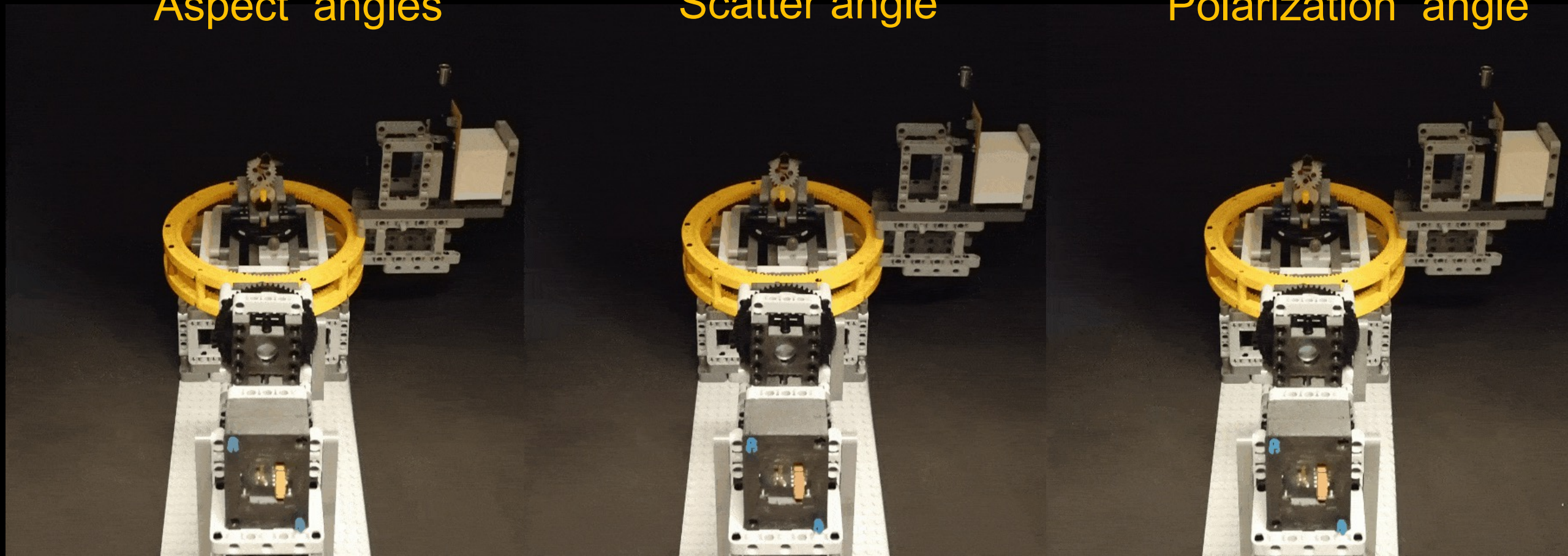
Hampus Månefjord,[1,a] Meng Li,[1] Christian Brackmann,[1] Nina Reistad,[1,2] Anna Runemark,[3] Jadranka Rota,[4] Benjamin Anderson,[5] Jeremie T. Zoueu,[6] Aboma Merdasa,[1,7] and Mikkel Brydegaard[1,3,8,9]

A 7-dimensional optical instrument for biophotonic investigation, Approximatly 10^7 unique pictures of the same object

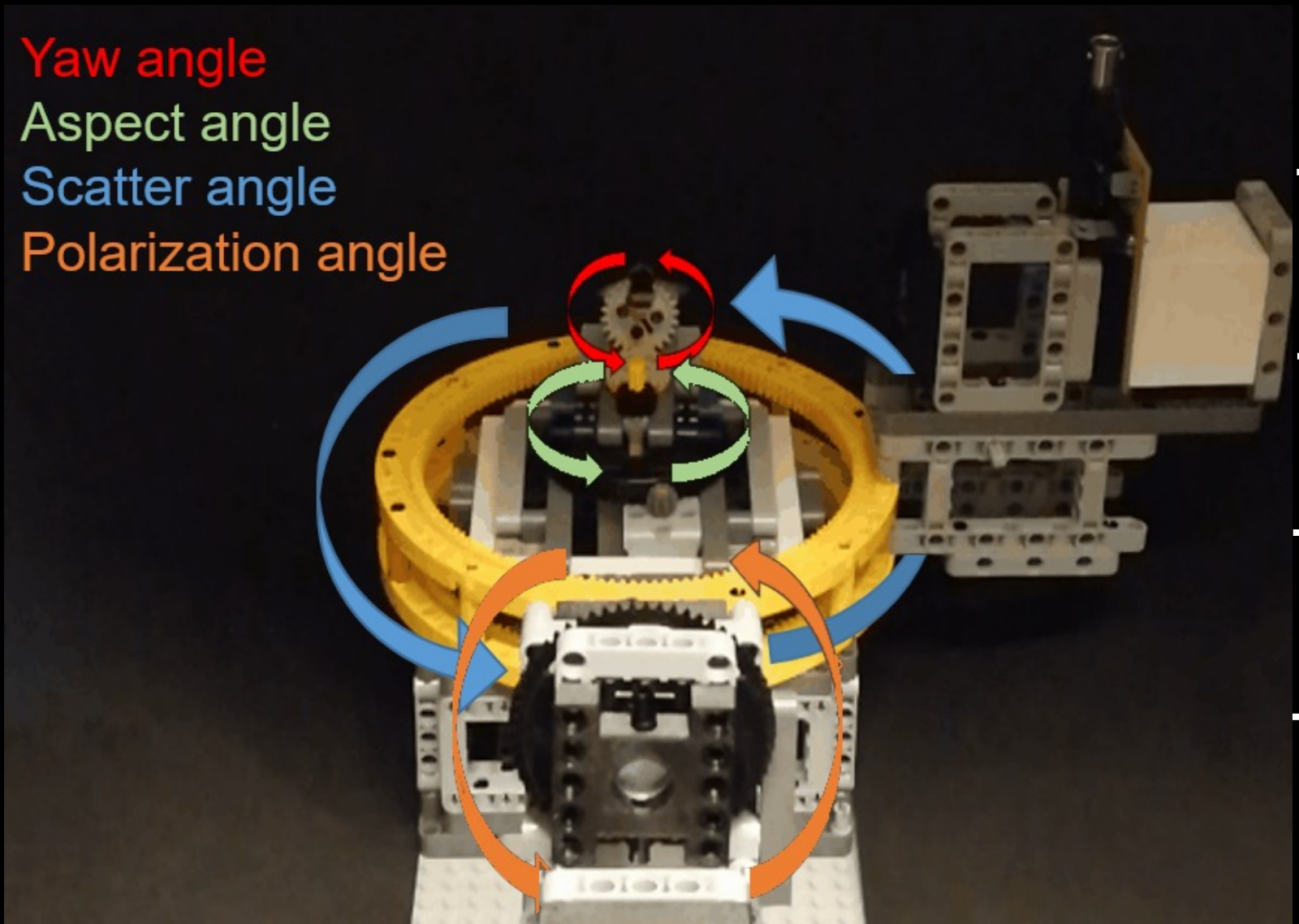
Aspect angles

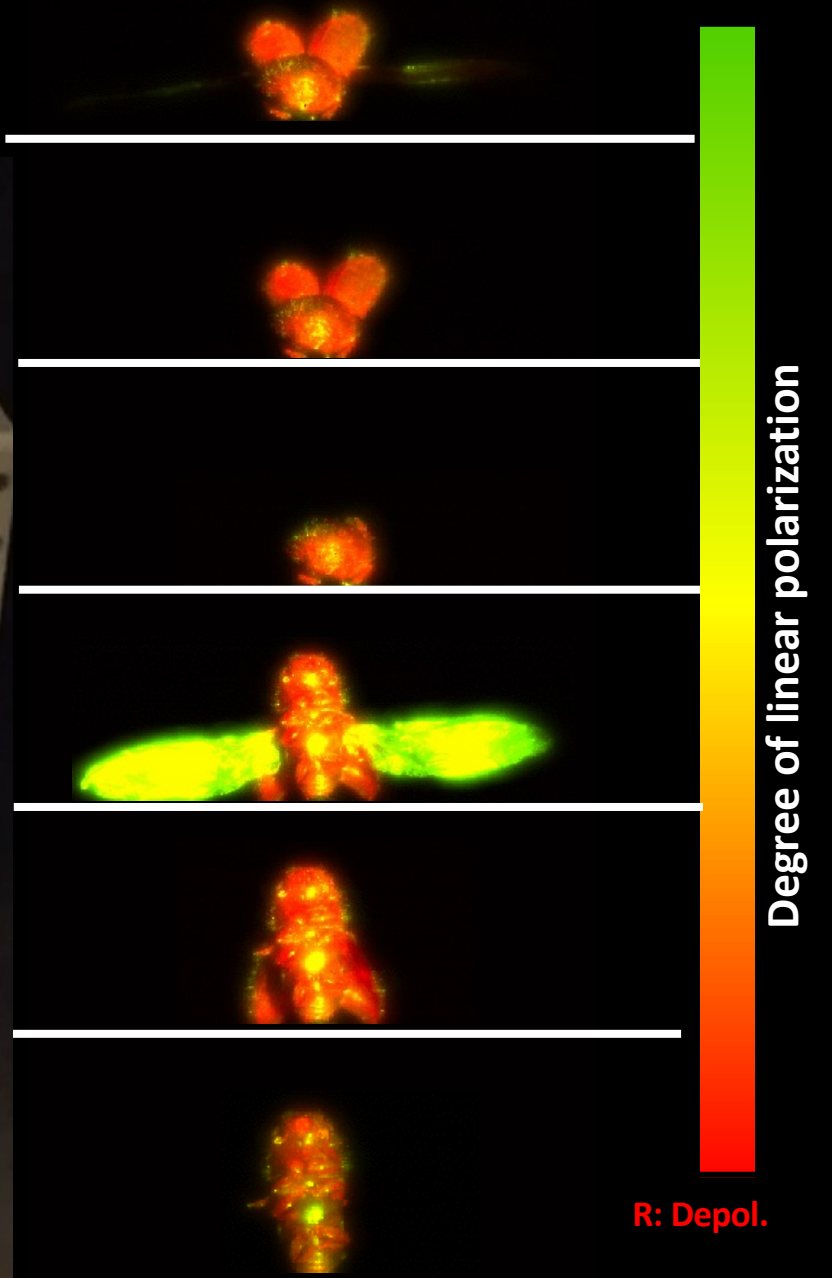
Scatter angle

Polarization angle

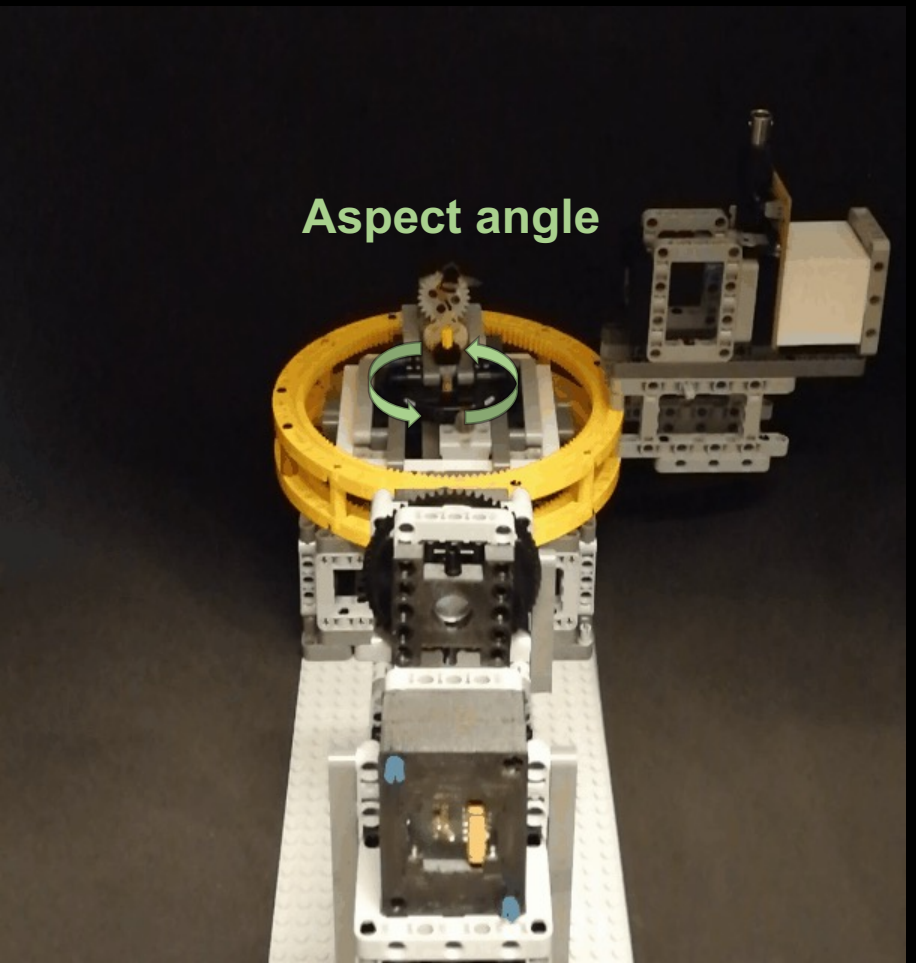


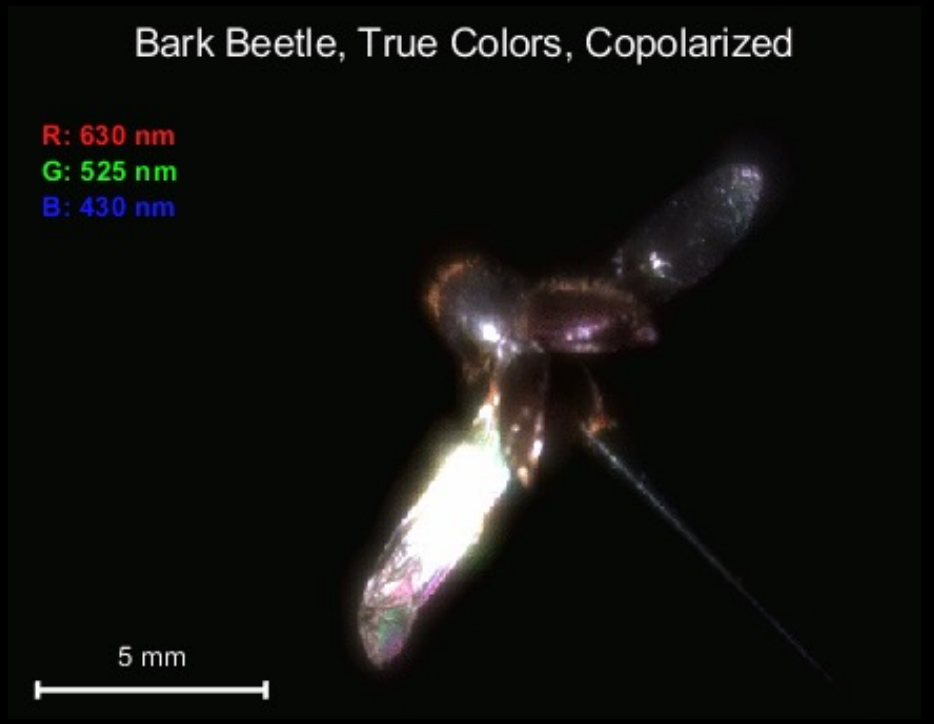
BIOSPACE – Bio Imaging Optical Spectral Polarimetric Angular Compact Equipment

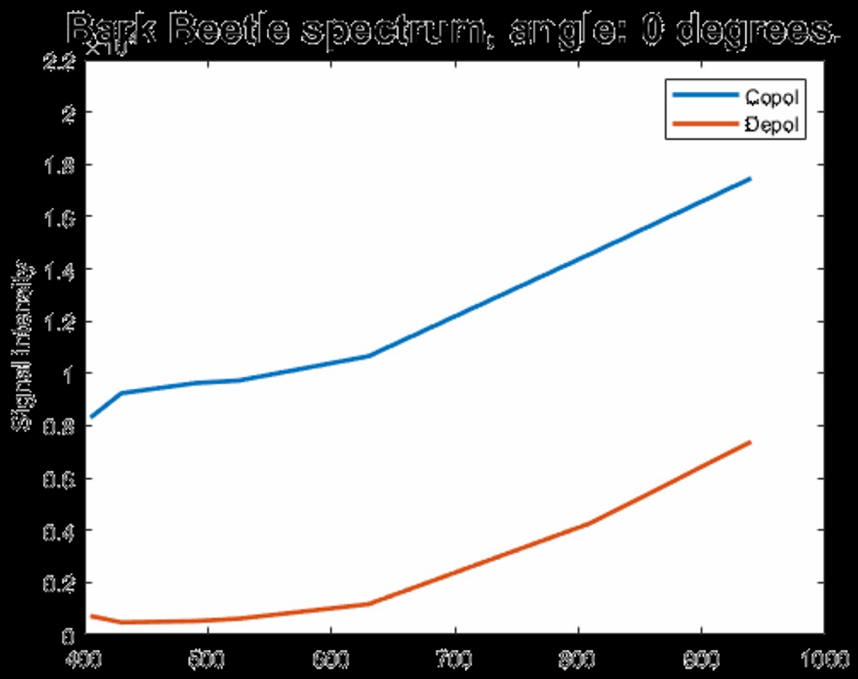


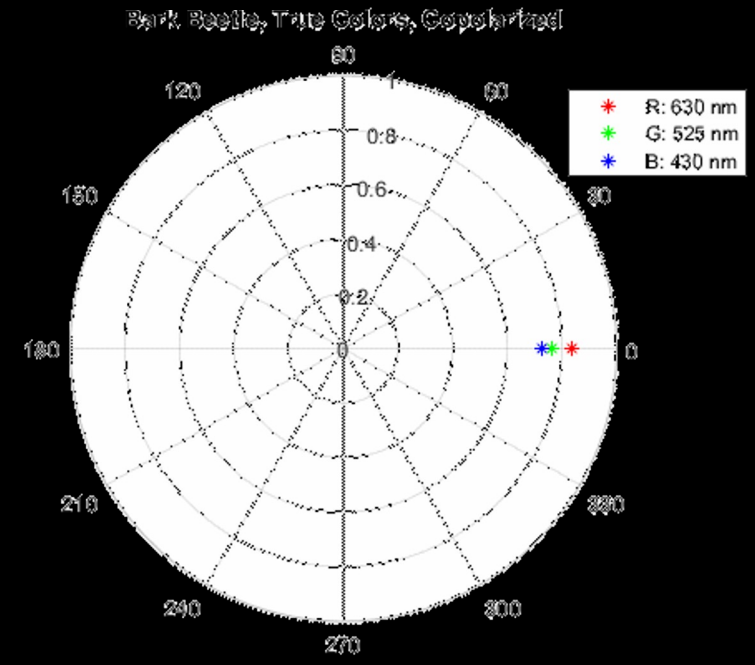


Projections from all angles

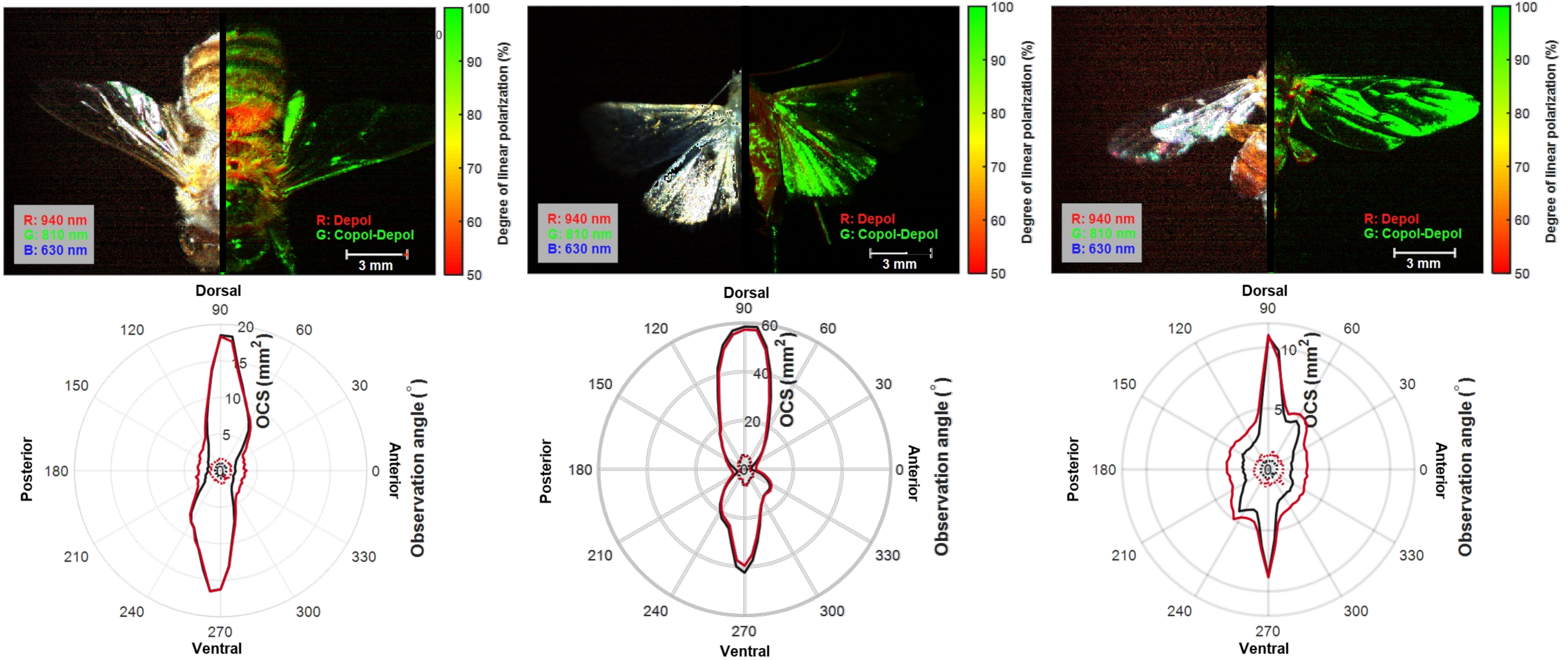








Characterized wing secularity and resonance can be associated with lidar echoes.



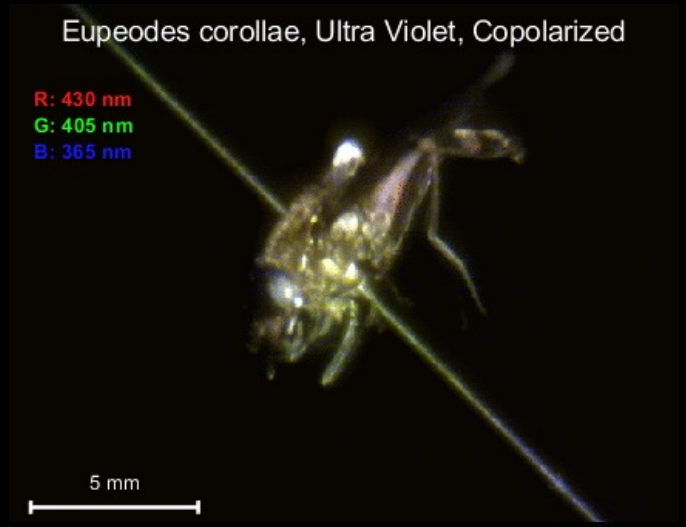
Multi purpose instrument for gaining understanding and searching for contrast in multiple domains

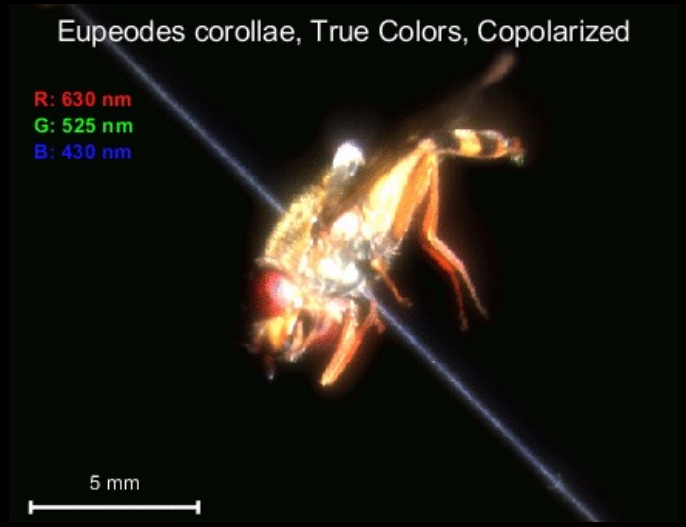
UV

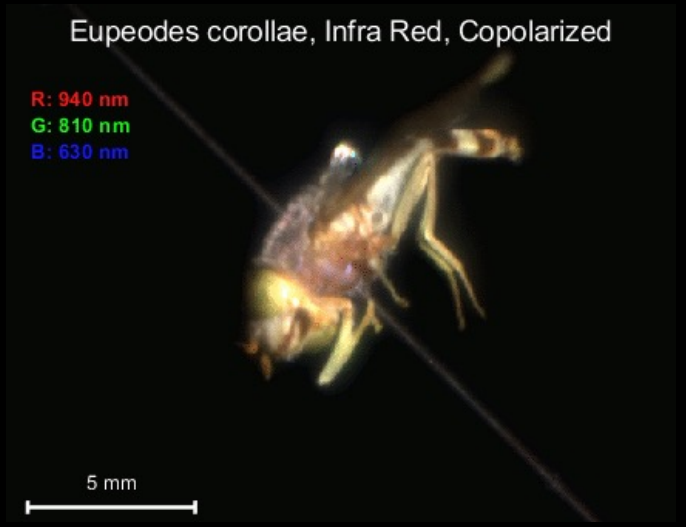
VIS

NIR

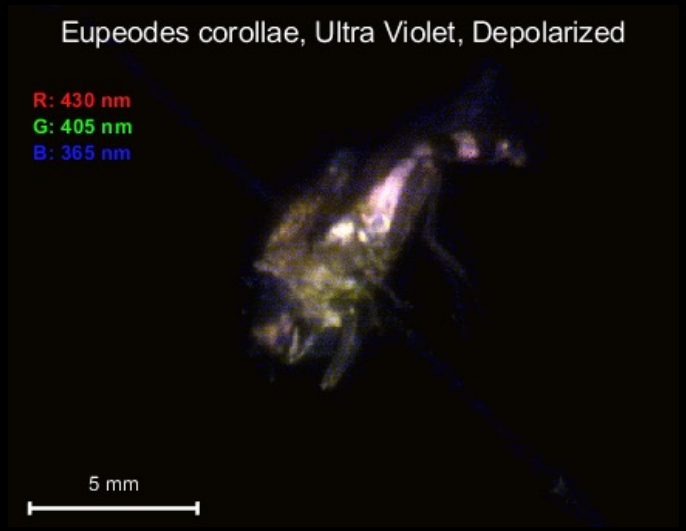
Co-pol.

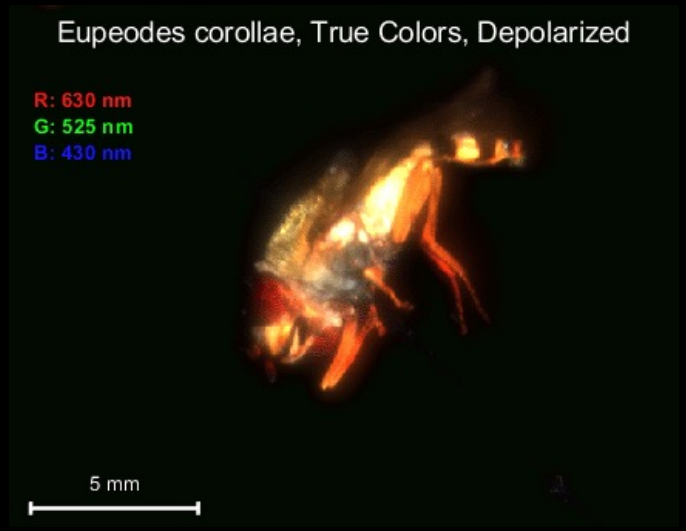


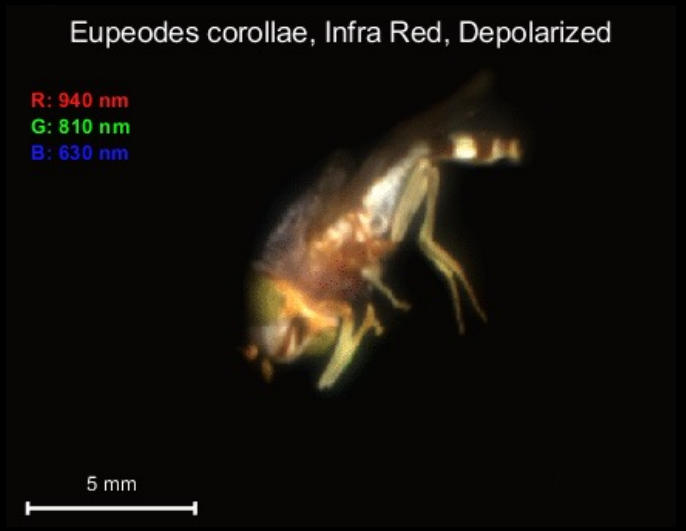




De-pol.







Thanks to all my student and collaborators!

Thanks for your attention!

Find us on YouTube!

Biophotonics Lund

@biophotonicslund653 14 prenumeranter 10

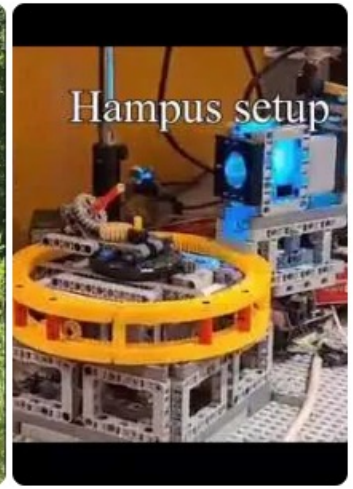
You are most welcome to learn more about bio

HEM VIDEOR SHORTS SPELLISTOR

Shorts

Bee gone, wasp nest

40 visningar



BIOSPACE in use

72 visningar

Sida

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