Drone-based tracking of white sharks near the surf zone

Andrew Colefax

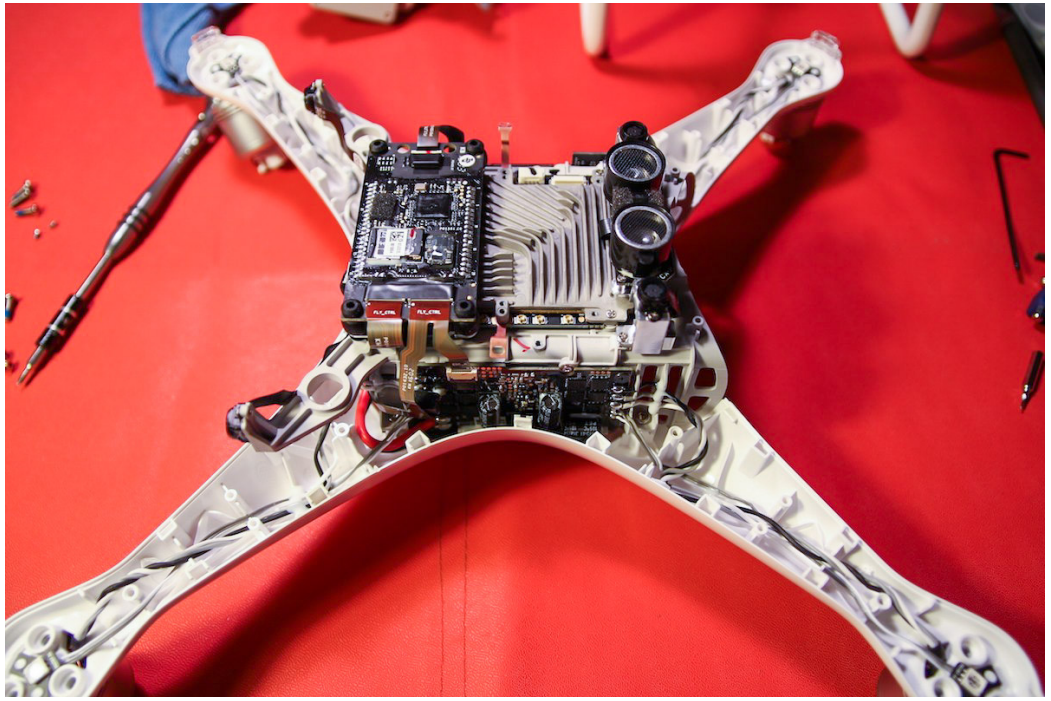
Paul Butcher, Brendan Kelaher, Dan Pagendam

How close is too close?

- Heightened sensitivity regarding sharks
- More search effort = more frequent evacuations
- When should a beach be evacuated?
- Public safety vs fear mongering

Drones are flying computers!

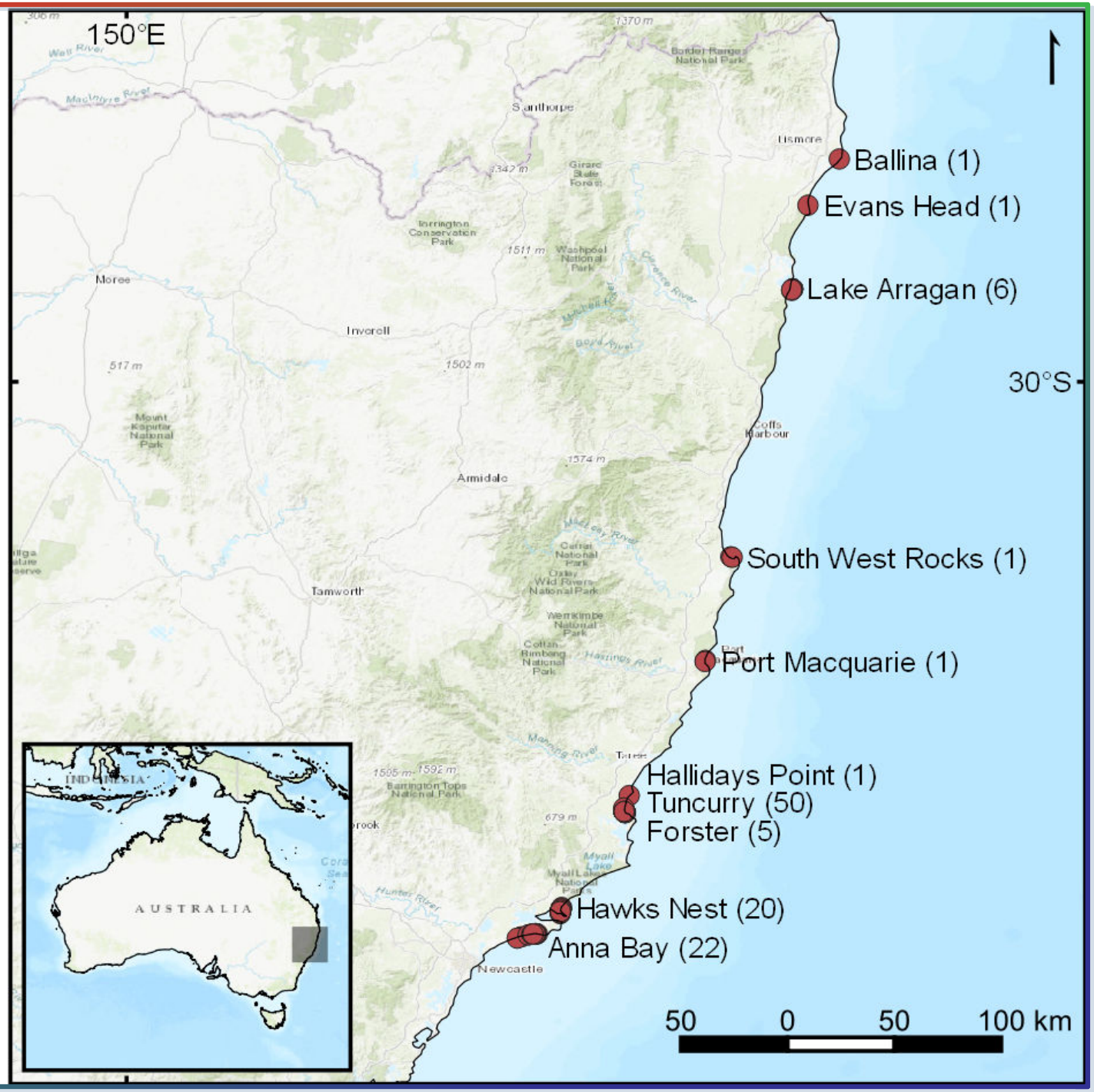
“Let your smartphone fly with Phone Drone”



- GPS
- Barometer
- IMU & Gyro
- Speed controllers
- Extra stored information

108 white sharks tracked

- 26.33 hours of footage
- Mean track time: 16.9 min
- Max 102.7 min



- Behavioural observation
- Location at a given time
- Speed
- Weather variables
- Shark length

Swim speed: avg 0.82 $m.s^{-1}$ (± 0.15)

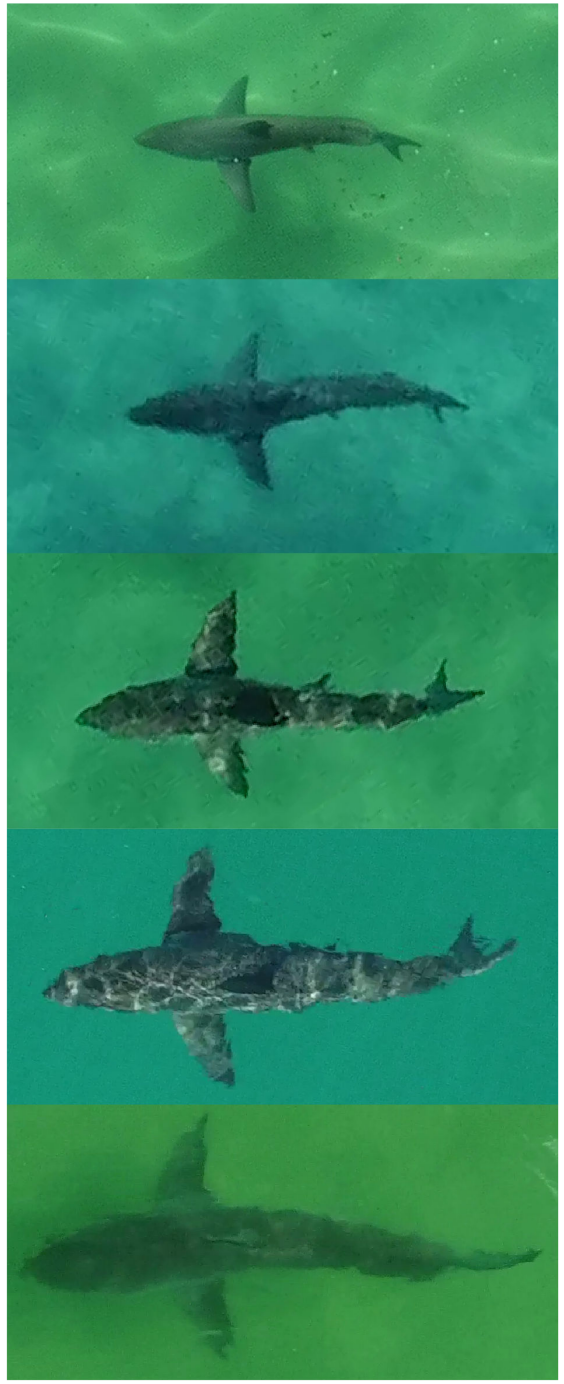
- ↑ Shark length (0.08 per m)
- ↑ Schools of fish (0.33 max)
- ↑ Other sharks and dolphins (0.08 max)

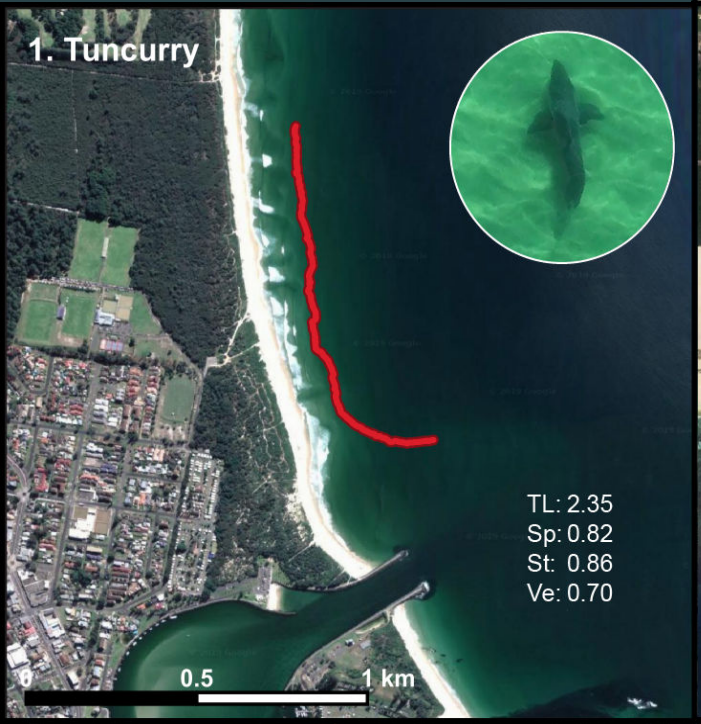
Straightness: avg 0.74 $m.s^{-1}$ (± 0.24)

- ↑ Shark length (0.12 per m)
- ↓ Schools of fish (-0.34 max)

Velocity: avg 0.61 $m.s^{-1}$ (± 0.23)

- ↑ shark length (0.15 per m)

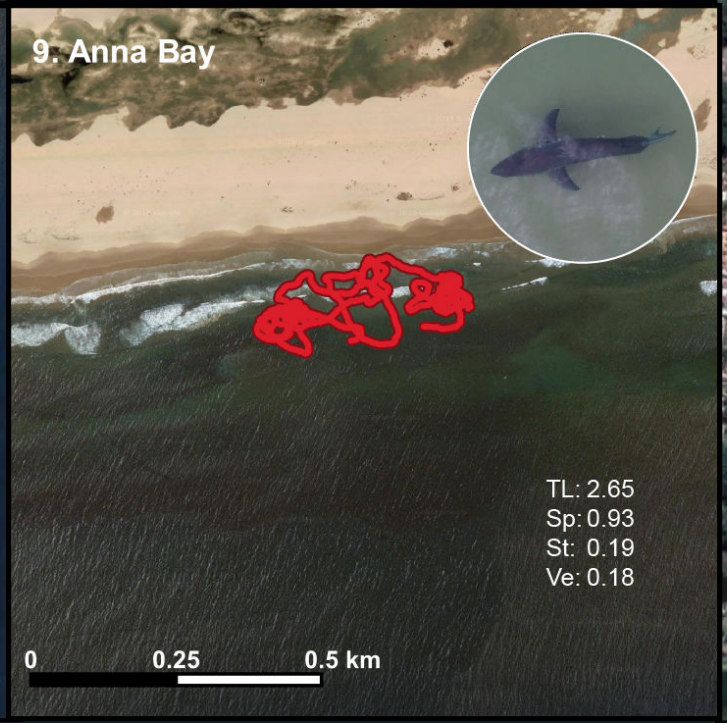



1. Tuncurry
TL: 2.35
Sp: 0.82
St: 0.86
Ve: 0.70
0
0.5
1 km

5. Anna Bay
TL: 2.81
Sp: 0.64
St: 0.84
Ve: 0.54
0
1
2 km

3. Forster - Tuncurry
0
1
2 km

7. Hawks Nest
TL: 2.09
Sp: 1.15
St: 0.70
Ve: 0.81
0
0.5
1 km


9. Anna Bay
TL: 2.65
Sp: 0.93
St: 0.19
Ve: 0.18
0
0.25
0.5 km

Conclusions:

- **White sharks move parallel to shoreline**

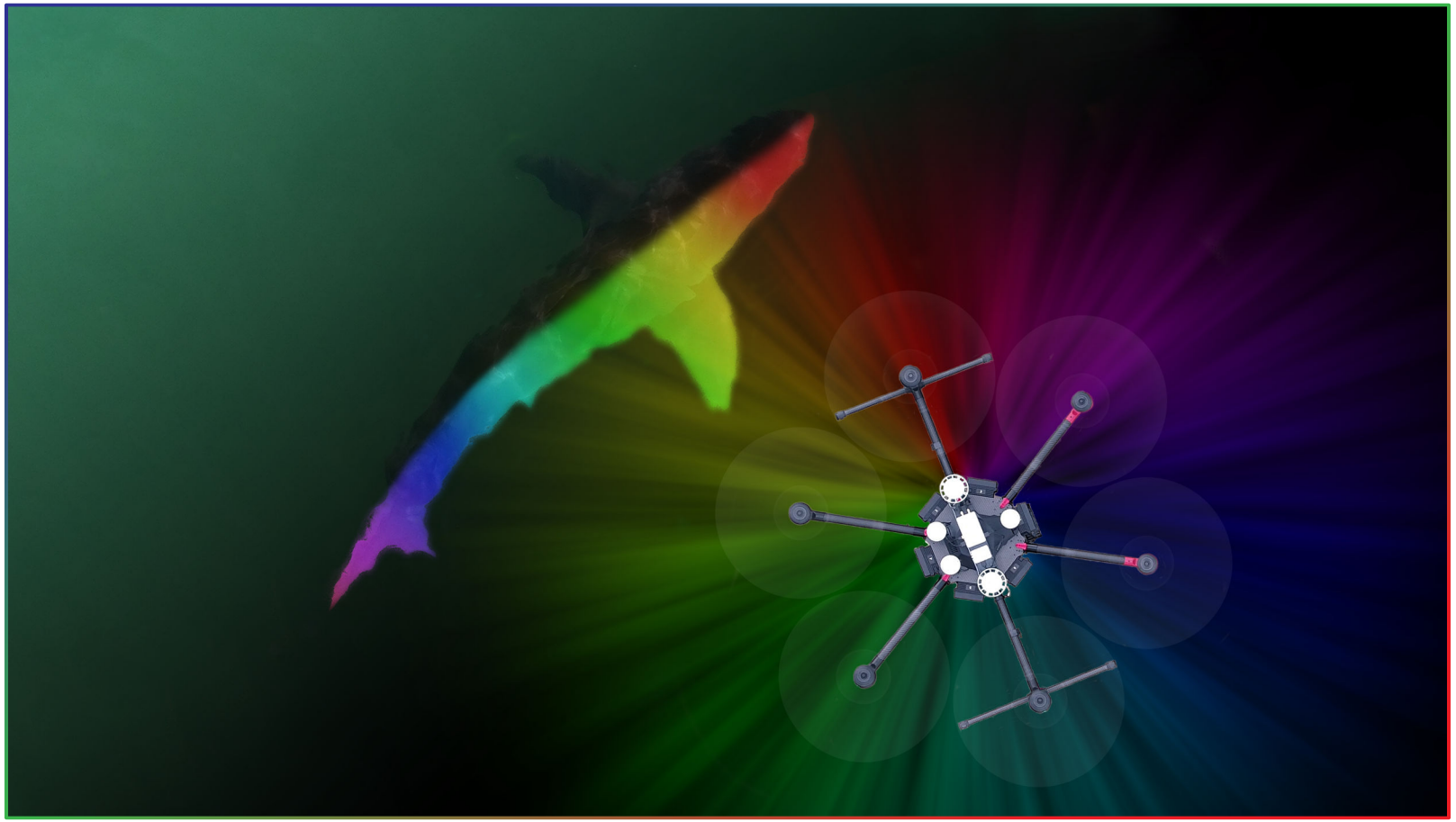
  … ***in a fairly straight line***

  … at slow speeds

- **Energy conservation and opportunistic foraging, rather than actively patrolling for prey**

- **Helps determine when a shark may pose a threat – fewer beach evacuations.**

Making a recipe with hyperspectral to increase detection reliability



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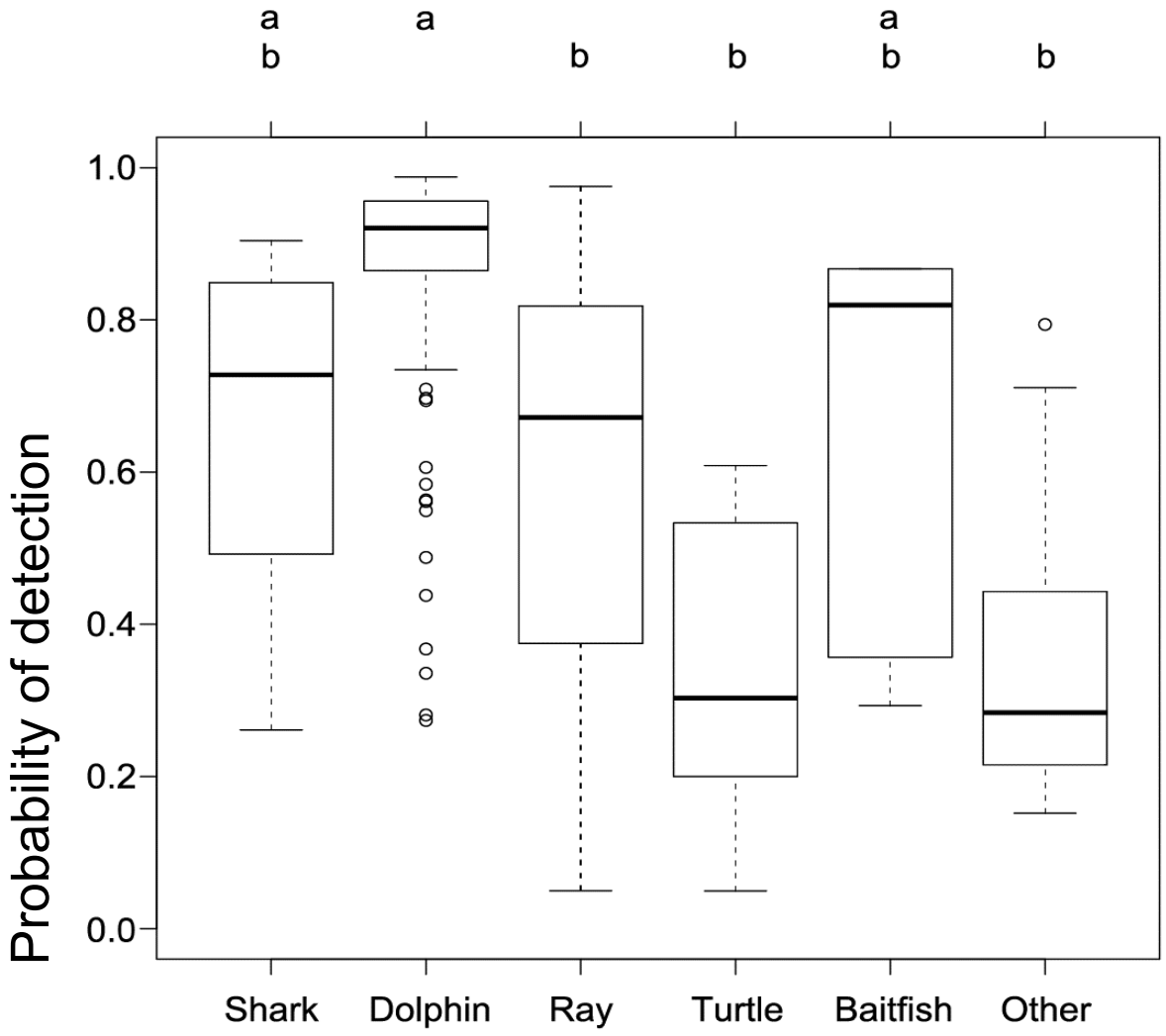
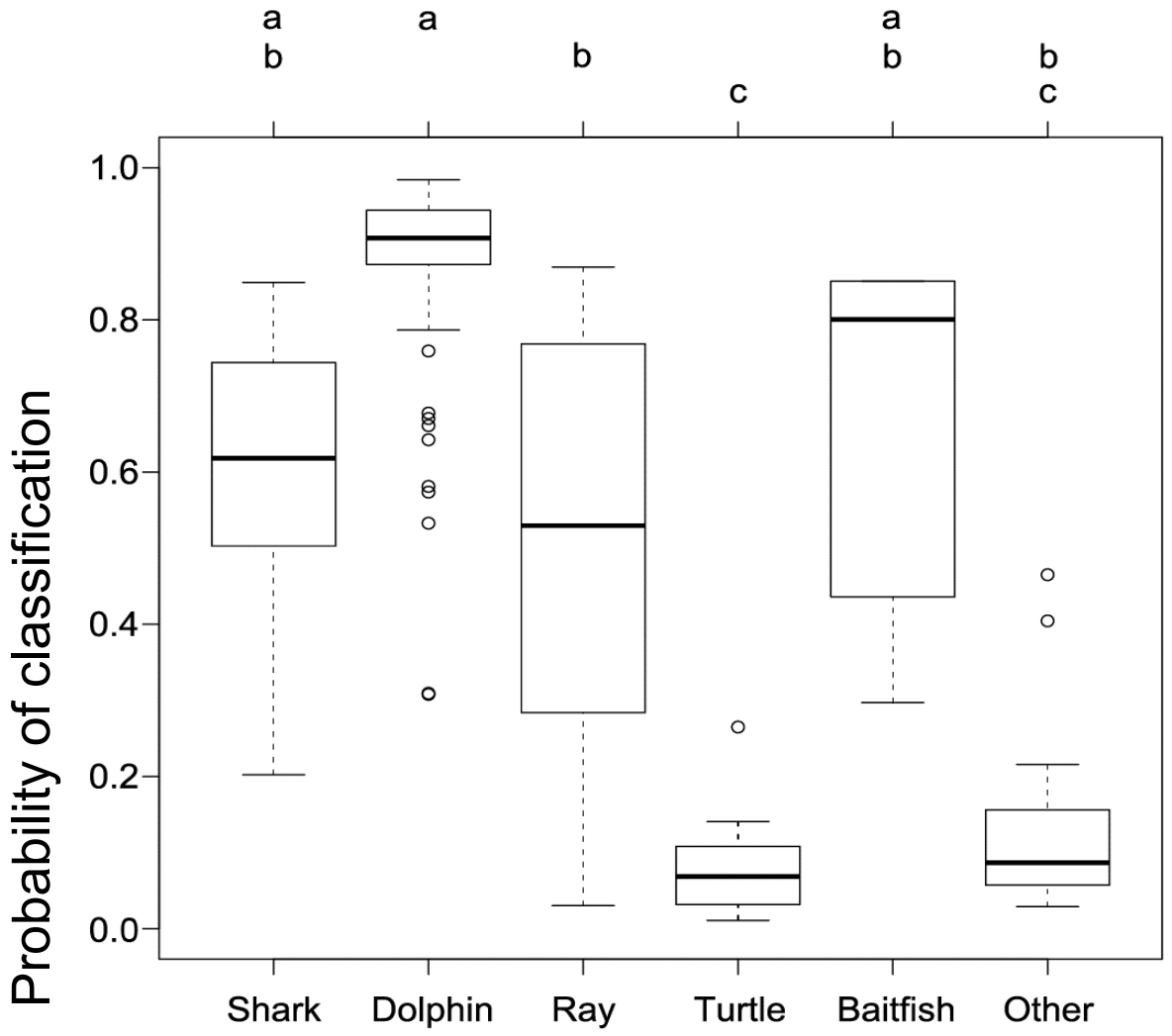
Drone-based field detections have room for improvement!

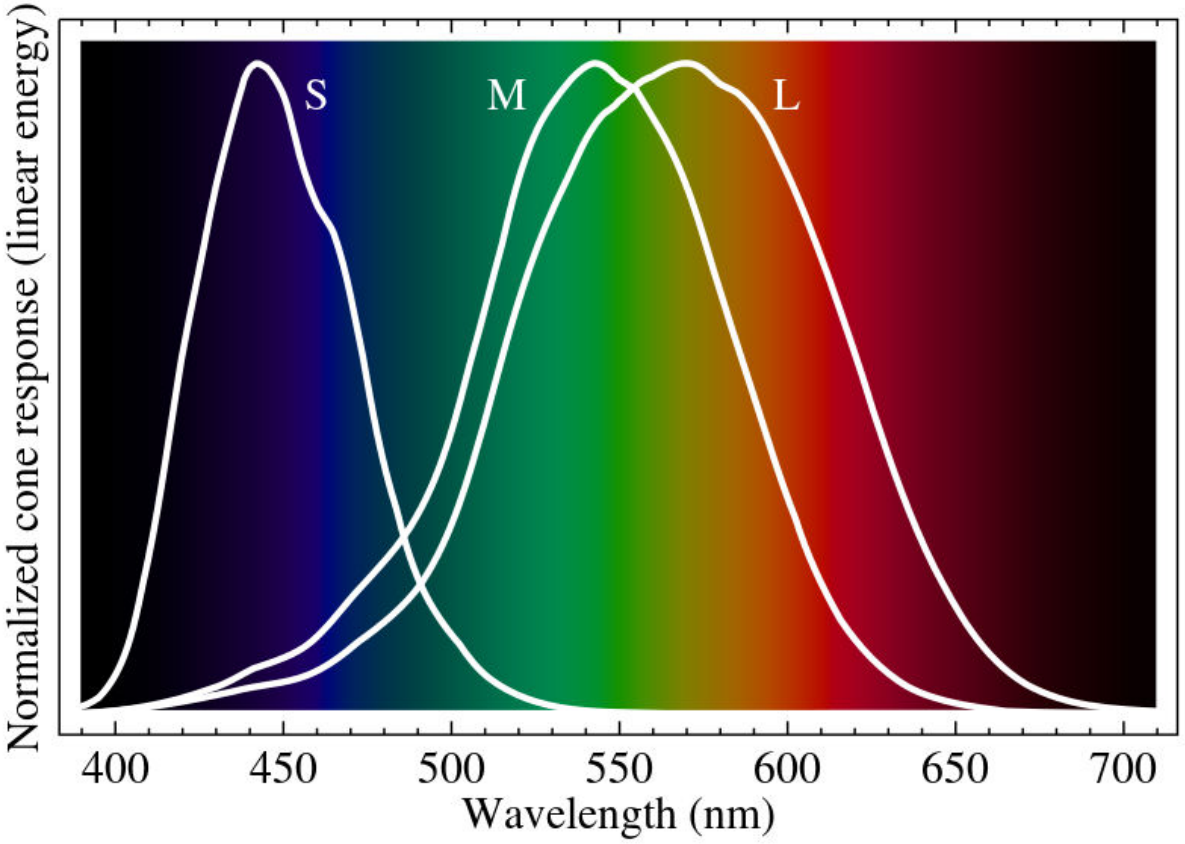


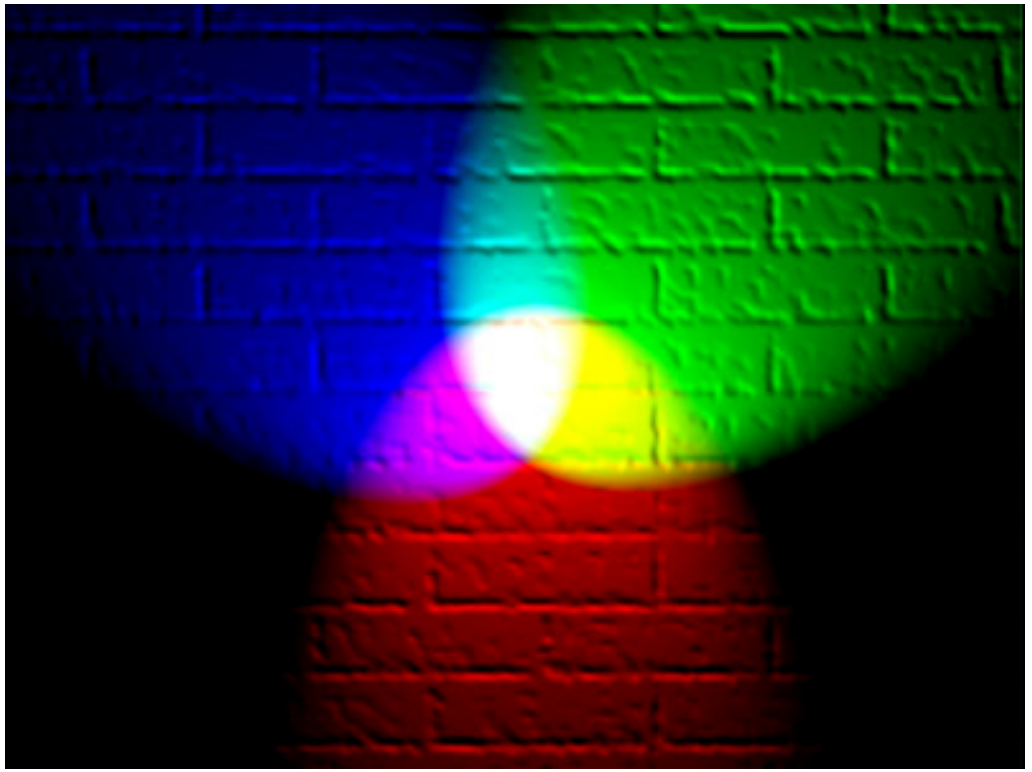


Colefax AP, Butcher PA, Pagendam DE, Kelaher BP (2019). Reliability of marine faunal detections in drone-based monitoring. *Ocean & Coastal Management*. 174, 108-115

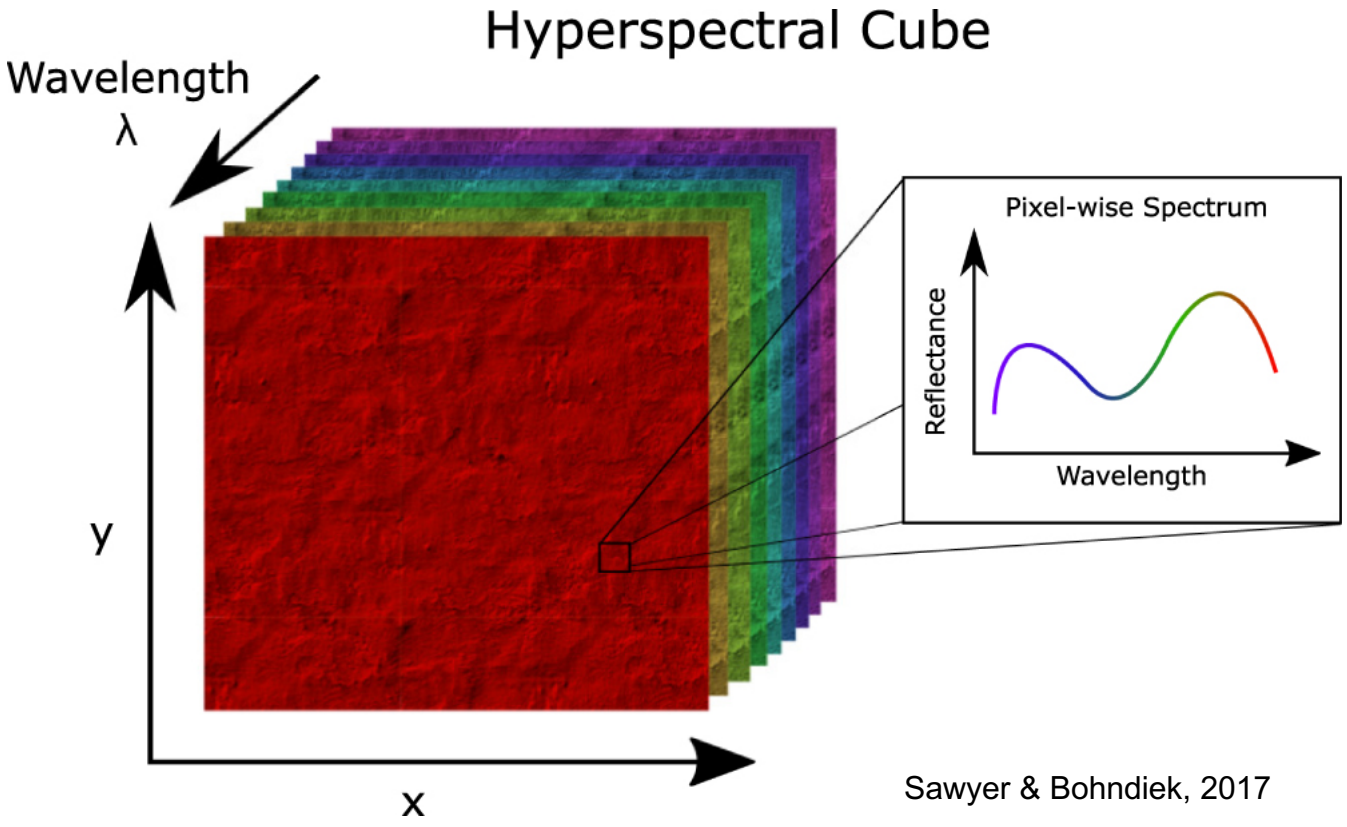
RGB Cameras:

- Mimic what human eyes see
- Our eyes have 3 colour photo receptors

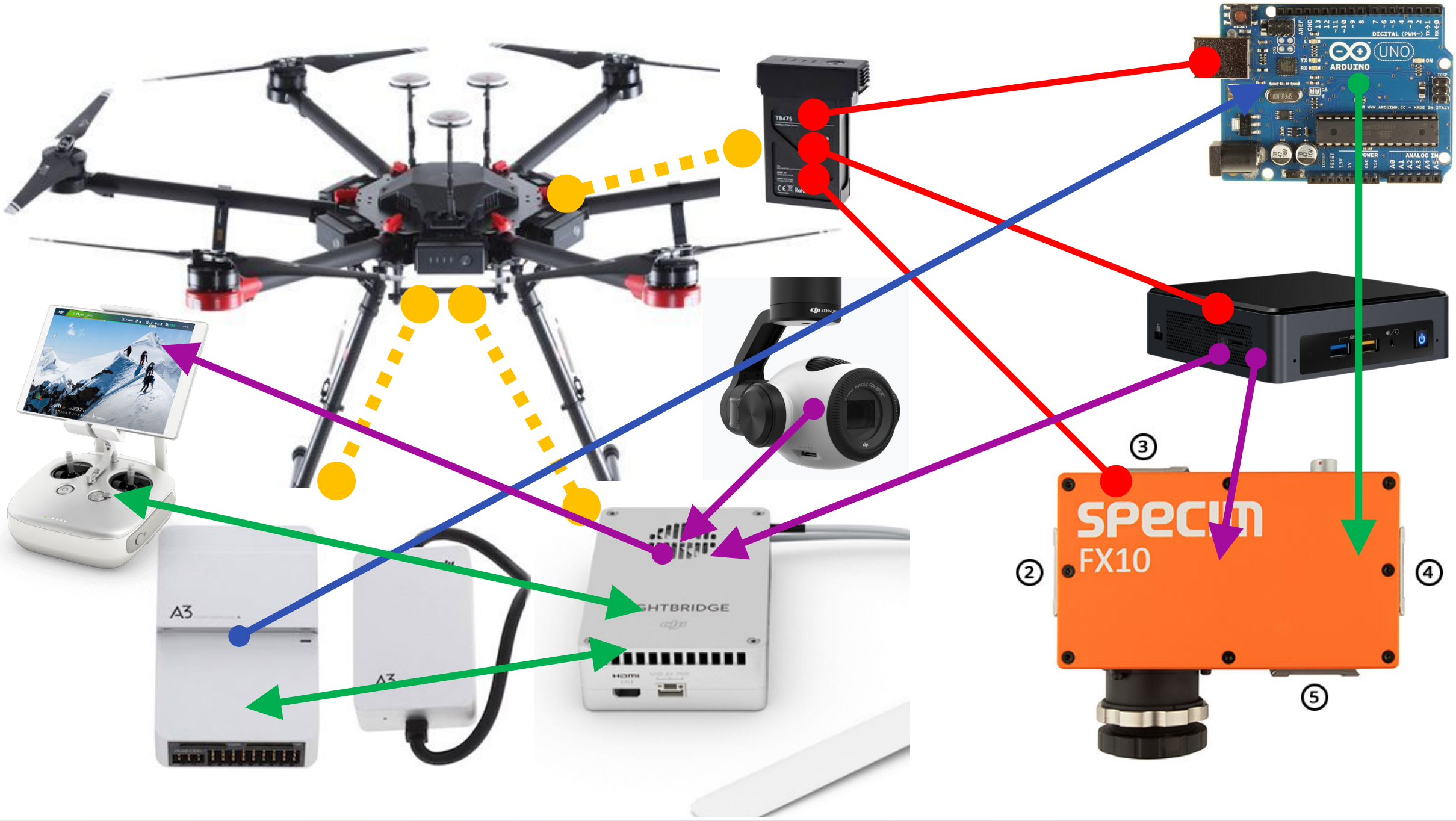




- Image representation via additive RGB colour mixing model



Sawyer & Bohndiek, 2017



UNO
ARDUINO
A3
A3
SPECIM
FX10
3
2
4
5

FX10