LiDAR as a tool for estimating seabird flight heights

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Seabird flight heights

- Understanding height at which seabirds fly key part of assessing collision risk
- Can be assessed using boat/digital aerial surveys, or GPS tags
- Significant uncertainty surrounding estimates from these platforms
- Patterns vary in both space & time

Johnston et al. 2014
Ross-Smith et al. 2014
Johnston & Cook 2016
LiDAR

• Light Detection and Ranging (light based Radar)
• Very precise measurements
• Widely used tool for ecology
  – Habitat mapping
  – Airborne insects
  – Aerial obstructions to aircraft
• Can we use it to measure the heights of seabirds in flight?
  – Validation
  – Field based survey
Validation

• Key question – can LiDAR accurately measure heights of moving objects?
• 3 Drones flown at known heights
• Drones detected on every flight
• LiDAR flight height estimates compared to those obtained using drones onboard GPS & photogrammetry techniques
• All estimates within 1m, minimum difference 17 cm
Surveys

- Aim for minimum 100 birds per species
- 300m above sea-level & speed of 240 km/h
- LiDAR point density 11 points m-2
- Camera GSD 3.5 cm
- Surveys 20th & 22nd September 2017
- N-S transects covered once each, E-W transects 3 times each
Image Processing

- Height of every point in the LiDAR cloud measured in relation to European Terrestrial Reference System 89
- Sea surface clutter meant it was necessary to filter out points <1-2m above sea level, potential for +ve bias to mean flight height estimates
- Points above 2m identified as birds
- Height estimates independent of height of aircraft
Image Processing

Speed of aircraft meant each set of points referred to a single bird

Points matched to photograph & passed to ornithologist for ID
Species detected

• Over 2,200 birds identified
• Most common gannets (377) & kittiwakes (806)
• Also, large gulls, auks, terns & great skua
• Issue with vibration in camera images (not sufficiently secured?) meant identifying gulls difficult
Flight heights

- Potential for birds flying at higher altitudes not to be detected when further from transect line

- Limit analyses to birds within 125m of transect line
Comparing flight height distributions

Kittiwake

LiDAR – this study


Boat – Johnston and Cook 2016, BTO Research Report No. 676

Gannet
Spatial distribution of flight heights

Collision risk height
Below CRH
Spatial distribution of flight heights

Gannet

Kittiwake
Combining distribution and flight height

Bird density

Flight height

Flight height with bird density overlaid
Conclusions

• LiDAR is an accurate & precise method for measuring seabird flight heights
• Sea clutter means data must be filtered – can detect birds > 2m or lower depending on conditions – may be possible to refine this
  • More important for auks etc. than gulls
  • Still precautionary (% birds at CRH will be overestimated)
• Can use data to produce continuous flight height distributions
• Can also look at spatial patterns in bird flight heights
Thanks!

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