Using LiDAR To Estimate Seabird Flight Heights

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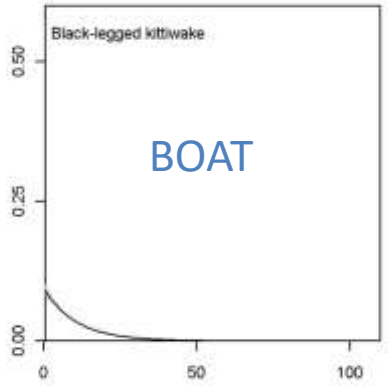
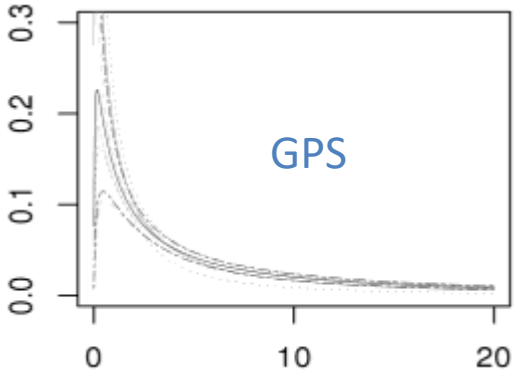
Seabird flight heights

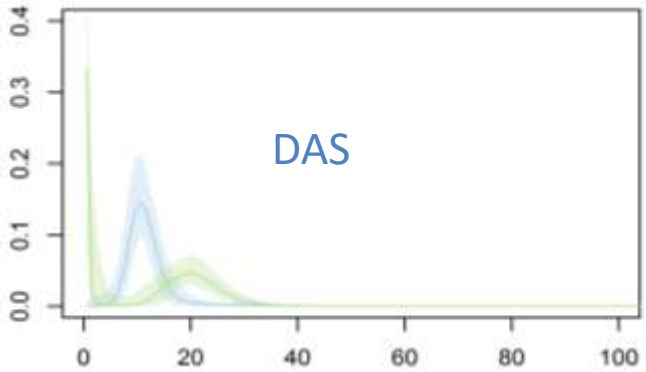
Johnston et al. 2014



Ross-Smith et al. 2014



Johnston & Cook 2016



- 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

LiDAR

- 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

- Key question – can it 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 of each 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

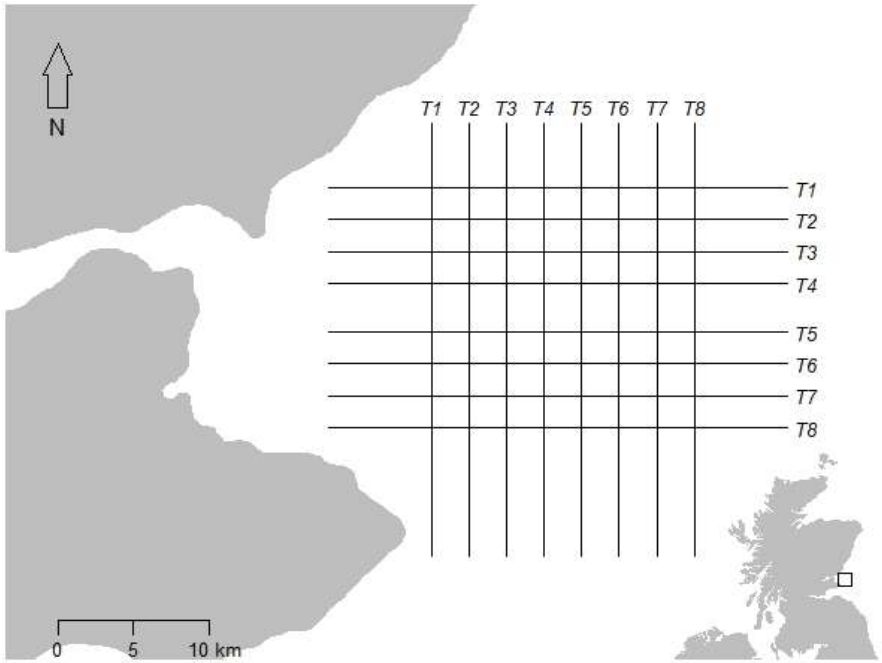


Image Processing

- 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

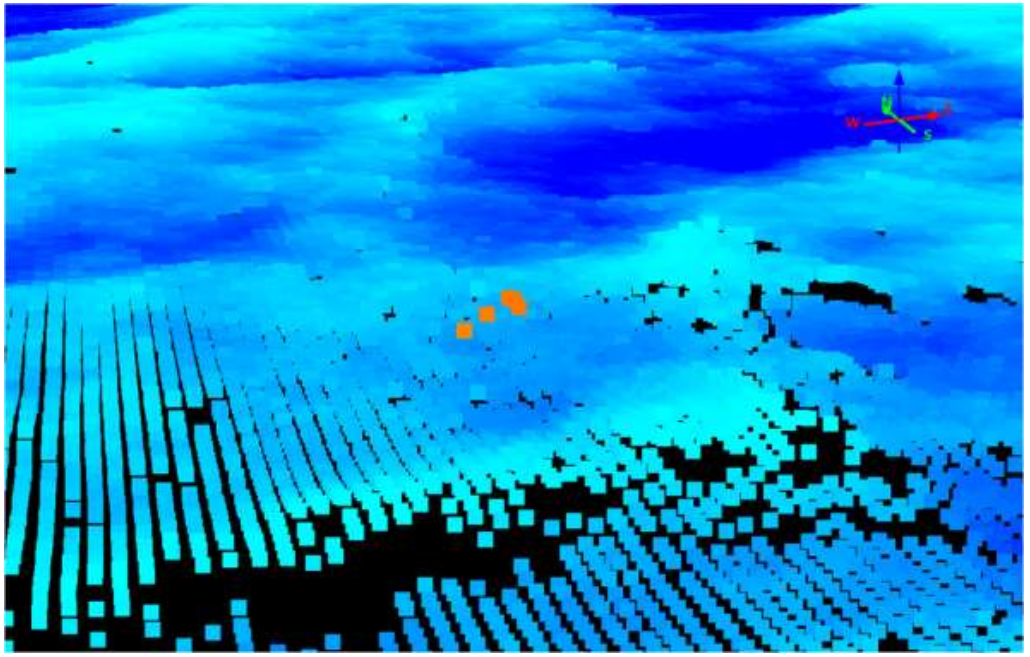
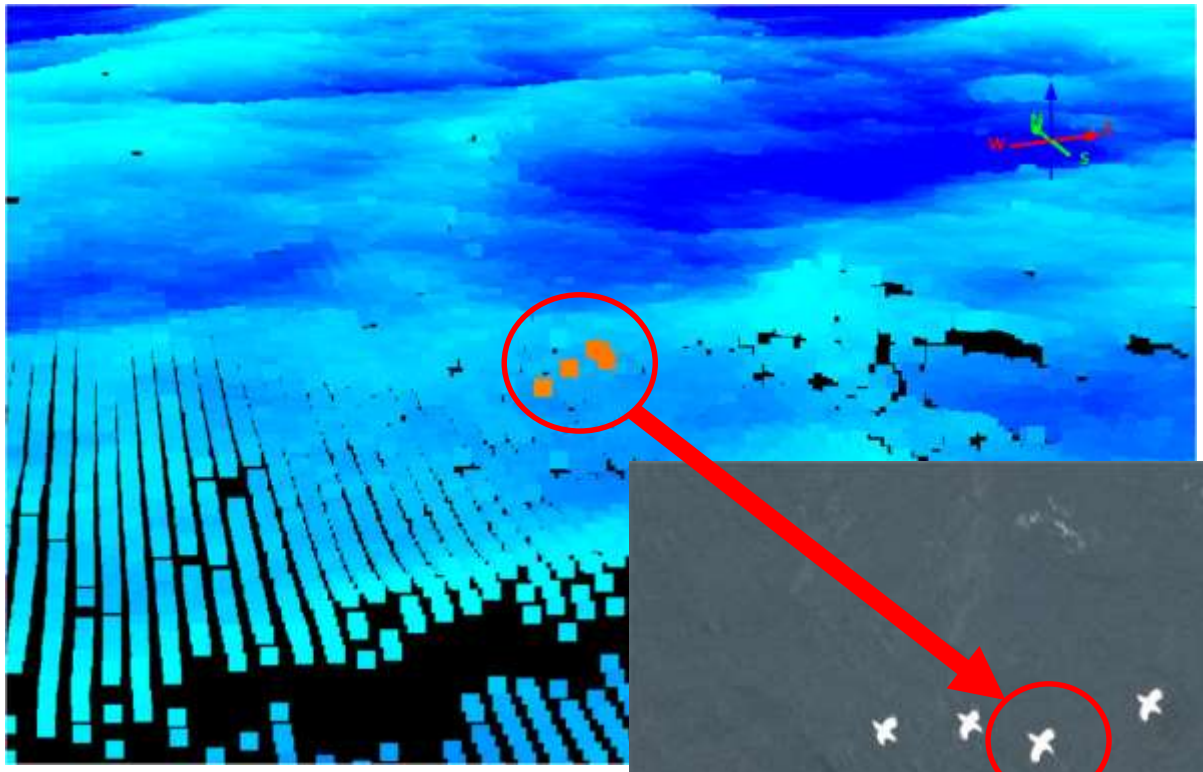


Image Processing



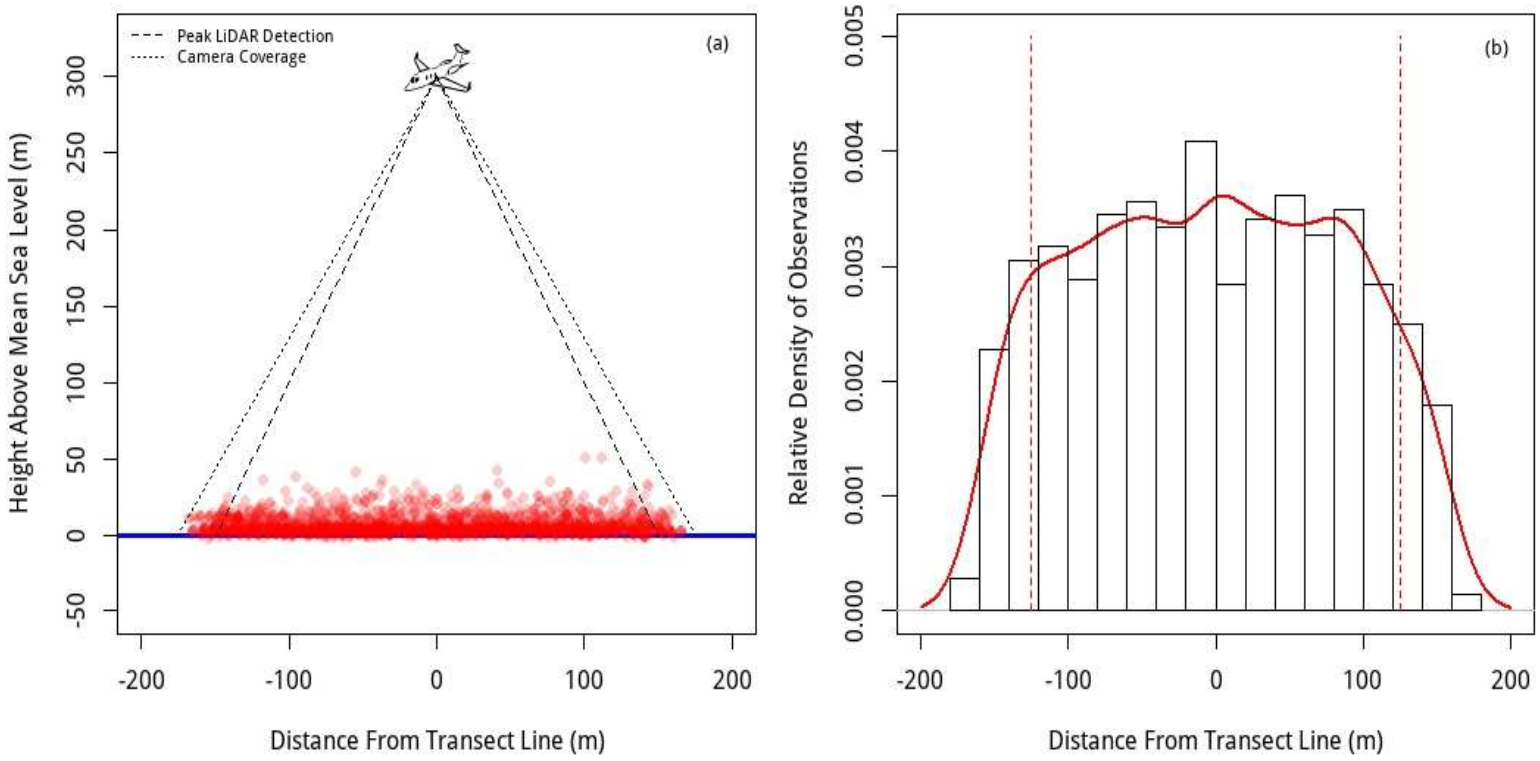
Points matched to photograph & passed to ornithologist for ID

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

Species detected

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

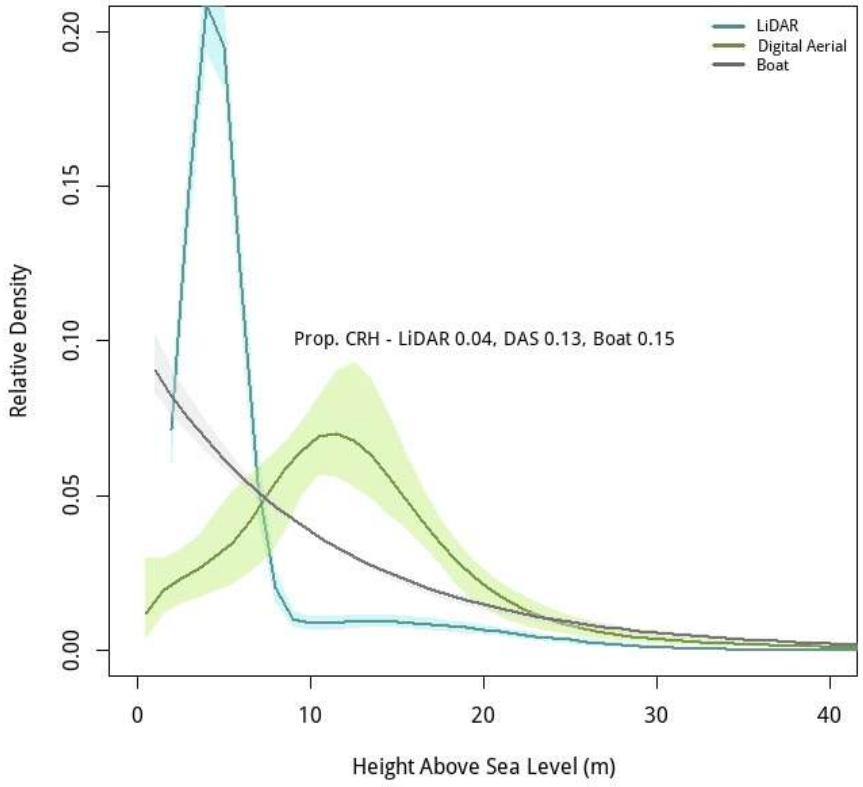
Flight heights



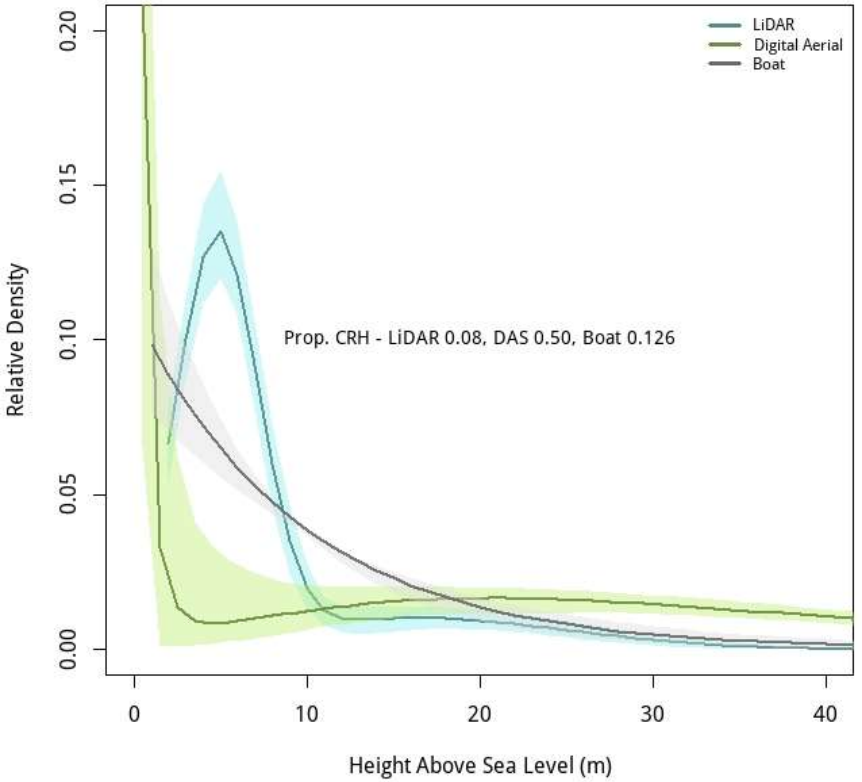
- Potential for birds further from transect line not to be detected when flying at greater altitudes
- Limit analyses to birds within 125m of transect line

Flight heights

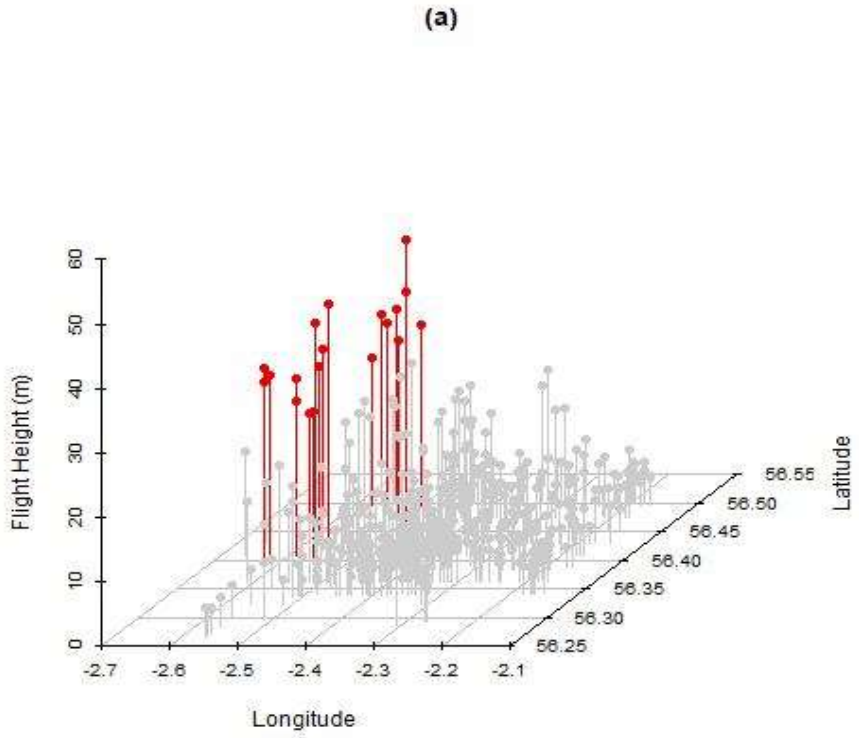
Kittiwake

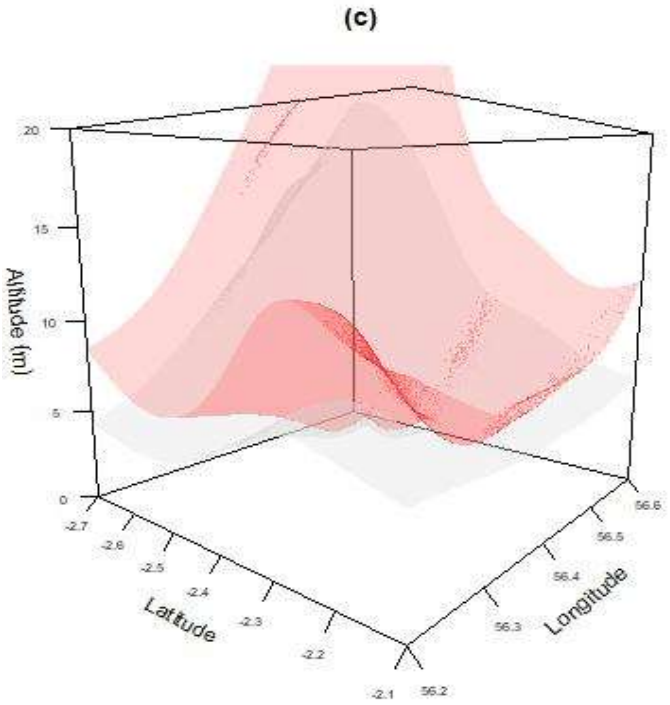


Gannet



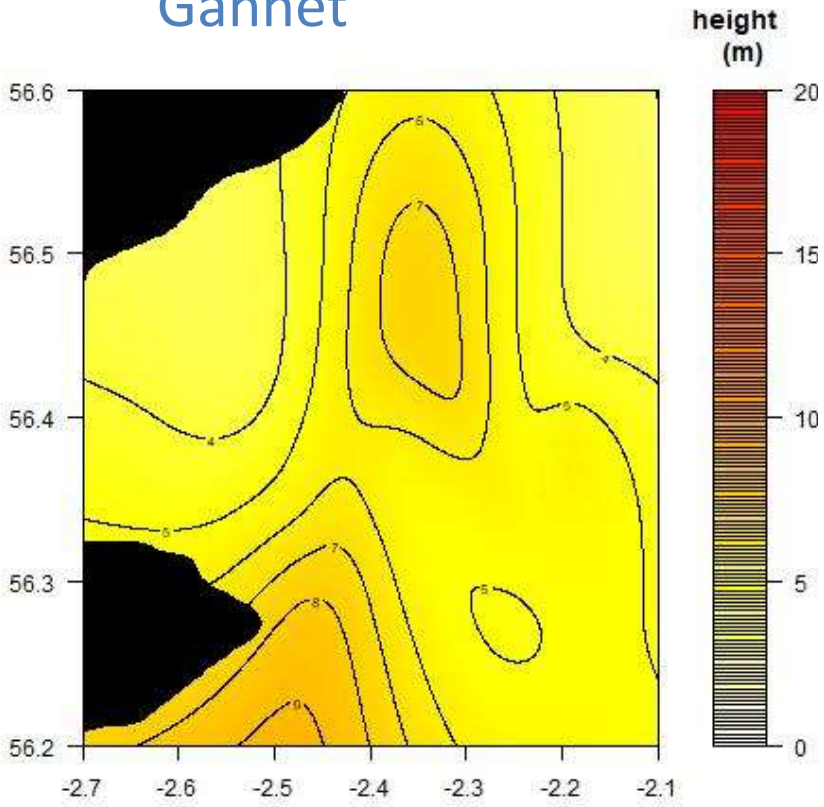
Flight heights



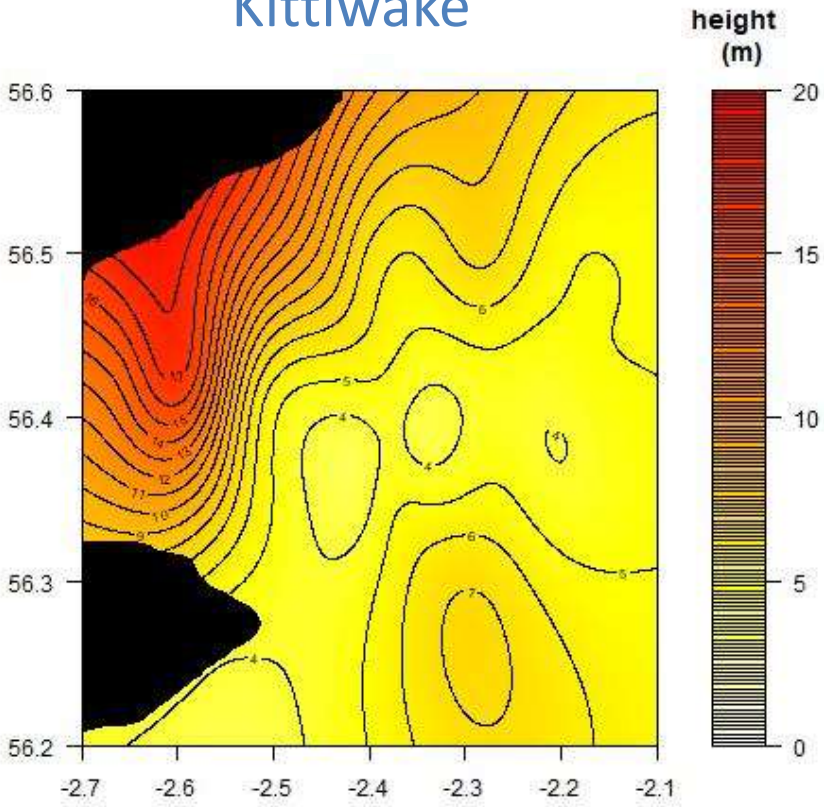


Flight heights

Gannet



Kittiwake



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

Acknowledgements

Work funded by Scottish Government Contract Research Fund

Scottish Government
Riaghaltas na h-Alba
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The Scottish Government's Contract Research Fund

- Thanks to Helica S. R. L. for supplying LiDAR equipment & Fugro for advice
- Thanks to Airtask Group for carrying out surveys
- Colleagues at BTO & NIRAS for support & advice on this project

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