

# Penguin Poo from Space

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## Summary

*Penguins and their breeding colonies are being affected by climate change.*

*The location and size of penguin colonies may show the extent of climate change and changes in the numbers of birds.*

*Freely available satellite images give a broad overview and the possibility of quickly identifying the location and extent of colonies.*

*This research has shown that penguin poo (guano) has a distinct spectral signature that can be used to identify, map and monitor colonies.*

## Research Aim

To investigate if satellite imagery could be used routinely to identify and monitor penguin colonies.

## Background Information

Antarctica is a difficult place to work in. Earth Observation (EO) satellites providing images over regular periods and wide areas can help. Their sensors record reflected radiation in different wavebands. Some of these are visible to the human eye but others are not. Different surfaces have different spectral signatures. Using these signatures it is possible to devise processing algorithms to identify specific materials.

Individual penguins are too small to be seen by the satellites but their colonies are much larger and so could be imaged.

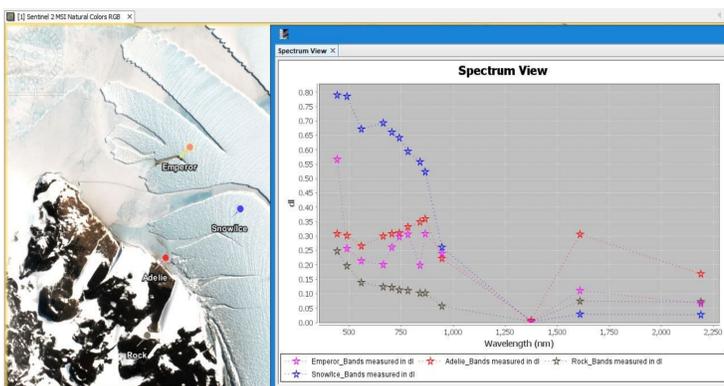
If the guano produced has a distinct spectral signature then processing of the images should provide a way to assess the state of the colonies.

## Experimental Method

Data from the Sentinel 2 satellite are available freely from the Sentinel Hub [1] and can be processed online using the EO Browser and SNAP analysis software [2].

Known colonies were chosen to examine the spectral signature of the guano.

The spectral signatures from different surface types around the colony were derived.



Four sample locations (Emperor and Adélie penguin guano, rock and snow/ice) were identified and the spectral information extracted.

There are obvious differences between Bands 8 and 4 for the different surface materials.

Based on this a processing algorithm was developed and applied to identify the penguin colonies.

The Normalized Difference Guano Index (NDGI) was calculated for each pixel.

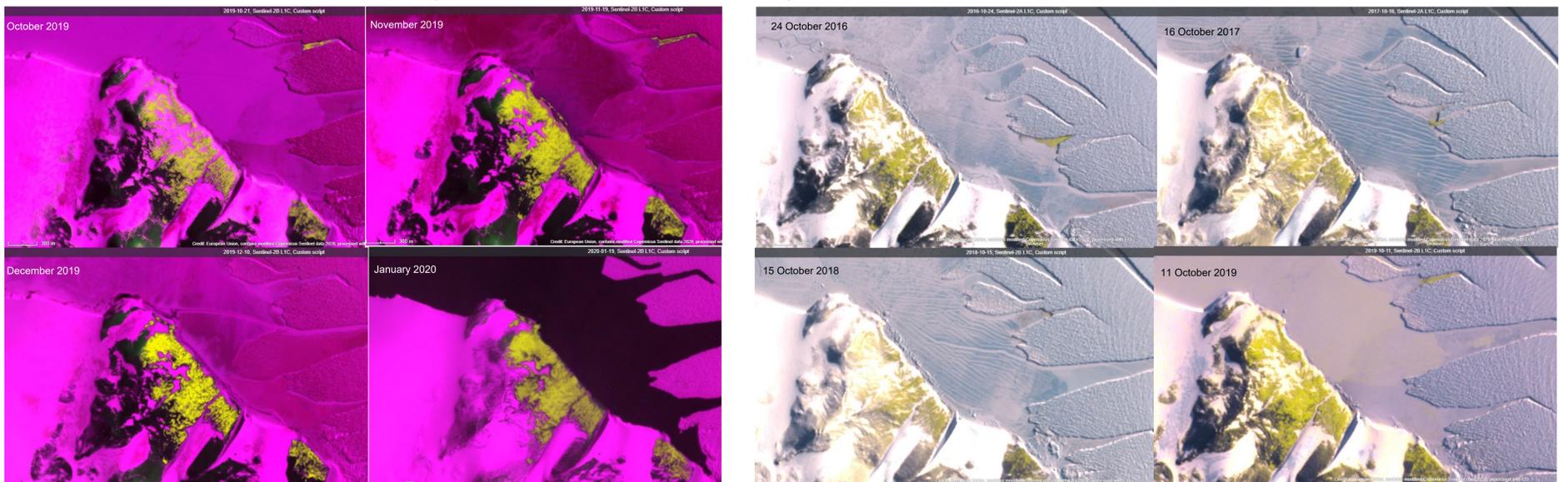
$$\text{NDGI} = (\text{Band 8} - \text{Band 4}) / (\text{Band 8} + \text{Band 4})$$

A high value of NDGI, in yellow, shows the penguin guano.



## Analysis

Earth Observation missions provide regular overviews of the same target area and over many years.



## Conclusions

Despite low spatial resolution, satellite images can be used to identify and monitor penguin colonies through individual seasons and over many years.

## Acknowledgements

[1] Sentinel 2 data available through Sentinel Hub EO Browser, Sinergise Ltd. [2] SNAP - Sentinel Application Platform, European Space Agency  
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