Spatial tools for conservation planning in remote spaces: end of project workshop

DPLUS065 Coastal Habitat Mapping Overview & summary of key outputs

#SouthAtlanticCoastalMapping

DPLUS065 Coastal Mapping Project – Grant aided by the Darwin Initiative through UK Government funding & supported by the FIG Environmental Studies Budget

Satellite image courtesy of Digital Globe Foundation

Project background

- Primary aim to improve the environmental evidence baseline for the Falklands & South Georgia
  - Provision of baseline data for the coastal margin
- Not a one-off: developing a legacy
  - Tools and frameworks
- Real challenges around remote island territories
  - Poor connectivity using large datasets

Satellite images courtesy of Digital Globe Foundation

Project overview

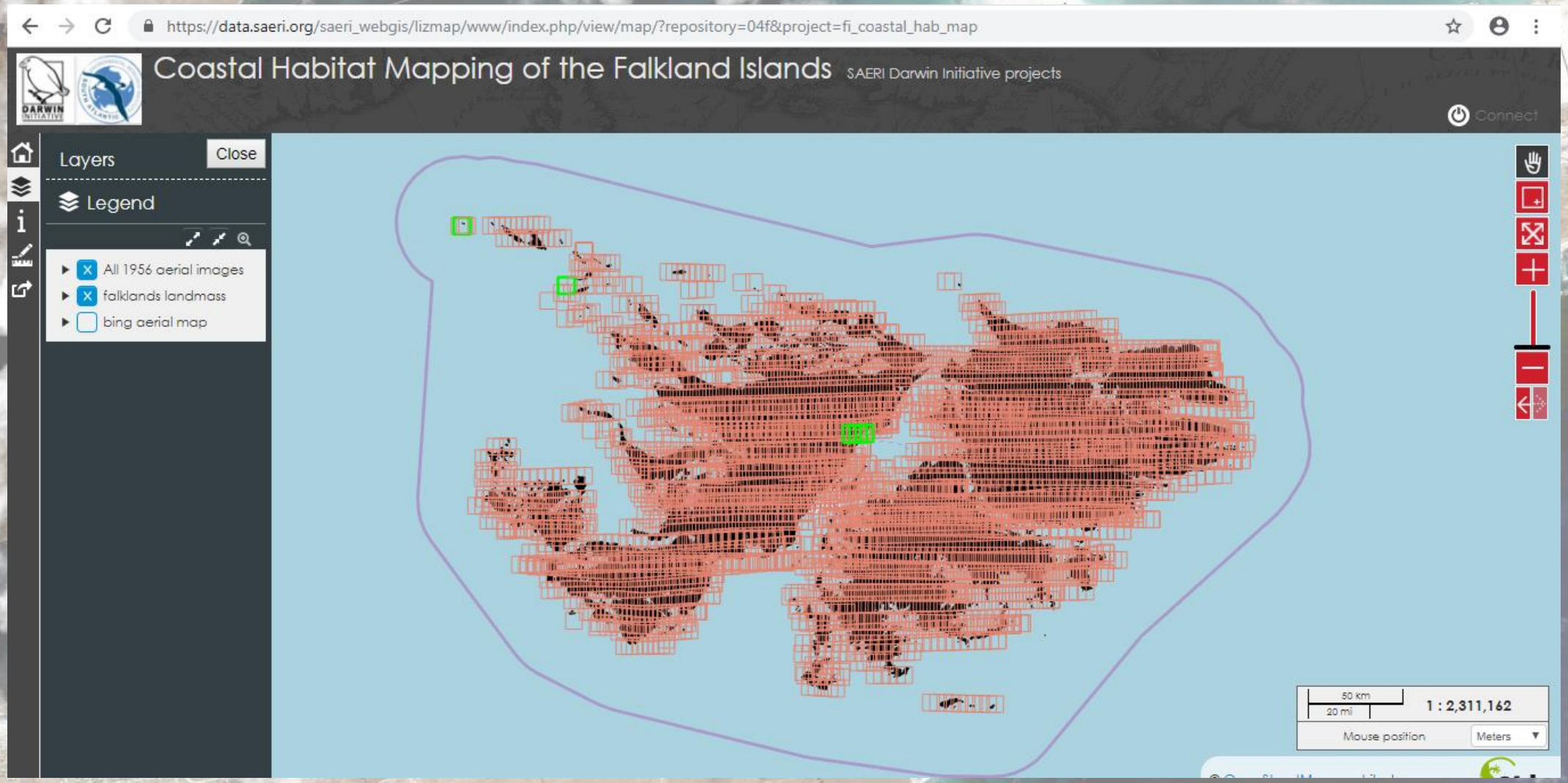
- Project formally started Summer 2017 – ends this month!
- Five Work Packages:
  - WP1 – 1956 aerial imagery (Falklands only)
  - WP2 – Broad-scale coastal habitat modelling/mapping
  - WP3 – Fine-scale coastal habitat modelling/mapping
  - WP4 – Prioritisation of ongoing planning/protection/monitoring
    - Coastal mapping/monitoring manual
    - Training workshop to build capacity
  - WP5 – Outputs integrated with existing/emerging initiatives
    - Review of initiatives
    - End of project synthesis workshop

WP1 - 1956 Aerial Imagery: geo-referencing

- Raw data (Tiff images) with FIG Dept. of Mineral Resources
- Huge data resource: 3,675 b&w photos – 458 Gb
- Innovative scripting by SAERI IMS data centre
- Creation of a digital map on the Coastal Habitat Mapping webGIS

https://data.saeri.org/falklands_habitat.html

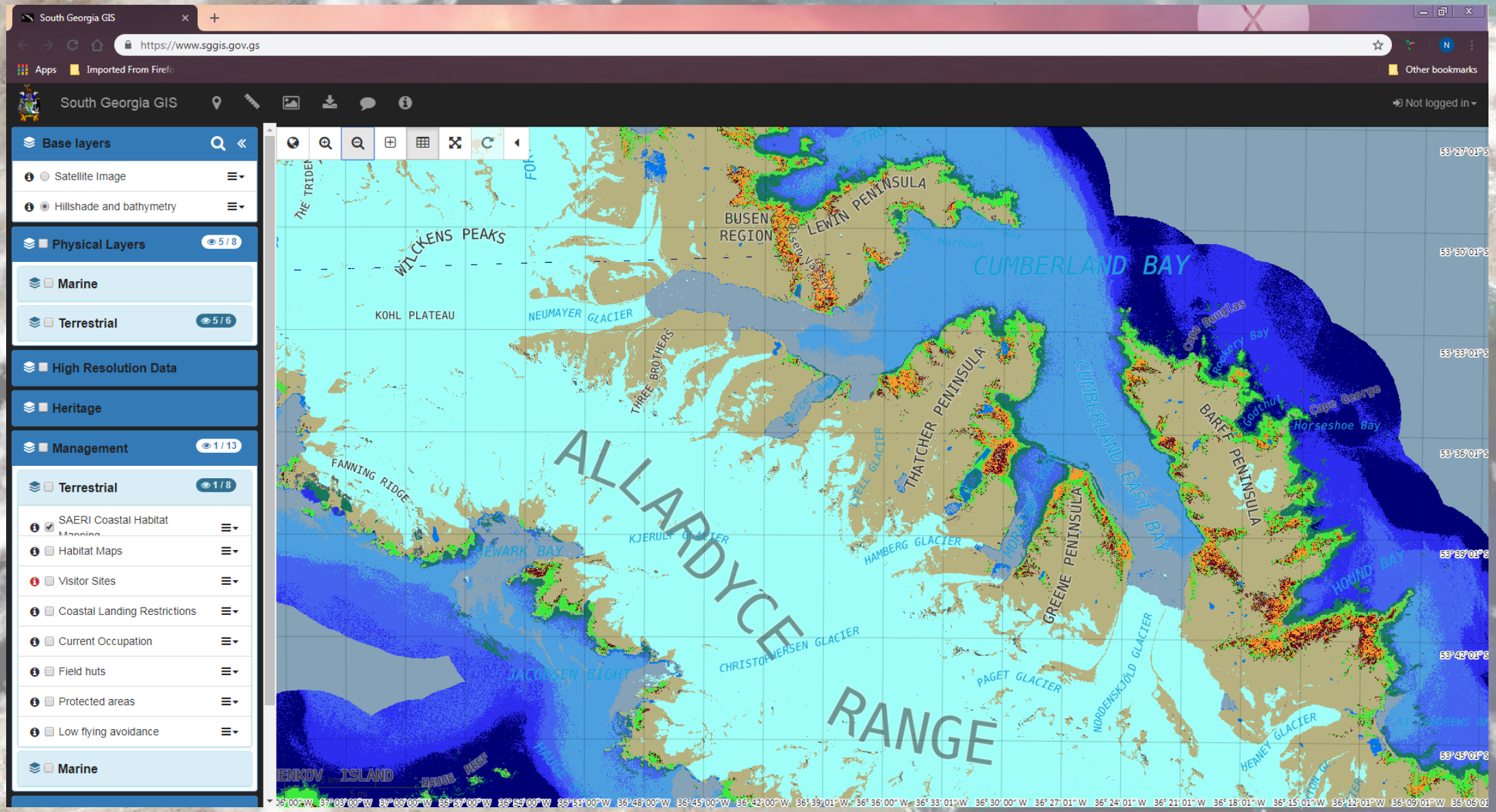
WP1 - 1956 Aerial Imagery: geo-referencing



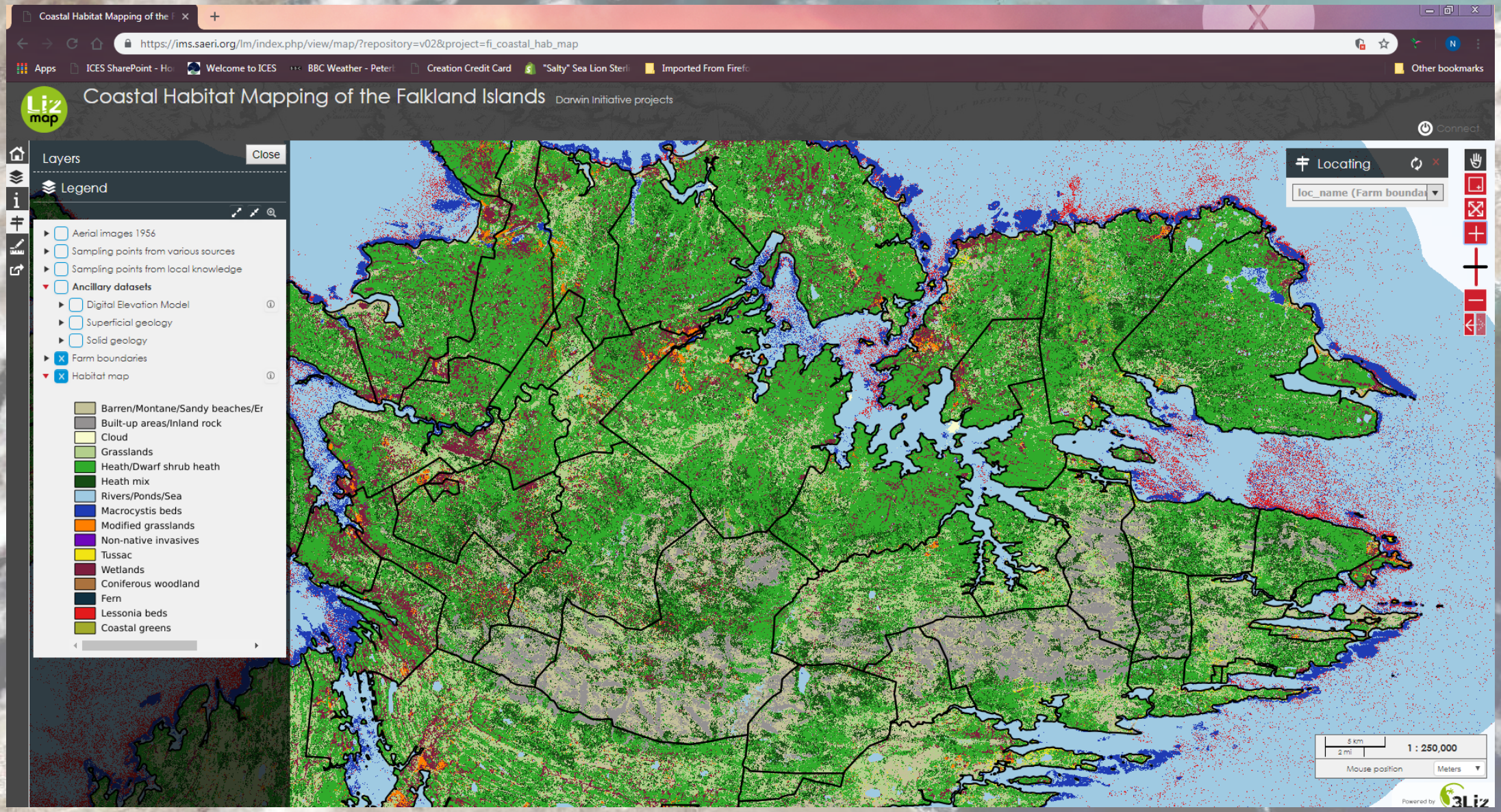
WP2 – Broad-scale habitat mapping

- Utilises Google Earth Engine random forest model
  - Extensive satellite imagery library “in the cloud”
  - Models can be re-run with new imagery in 5/10 years time – monitoring potential
- Software trained to classify “free to access” satellite data (10m resolution) using ground validation data.
- South Georgia broad-scale maps delivered July ‘18
- Falklands broad-scale maps delivered October ‘18
- Confusion matrix indicates the confidence in modelling different habitat types.

WP2 – Broad-scale habitat mapping



WP2 – Broad-scale habitat mapping



WP3: Stakeholder fine-scale prioritisation workshops

- Two successful workshops held
- Reports published on project website
- Clear steer provided on fine-scale mapping priorities

WP3: Stakeholder fine-scale prioritisation workshops

South Georgia

Falkland Islands

WP3: Stakeholder fine-scale mapping priorities

Falkland Islands

- Cape Pembroke/Stanley Common
- Steeple Jason
- Port Sussex (calafate mapping)
- Minefield 7
- Data integration case study – Cochon/Port William

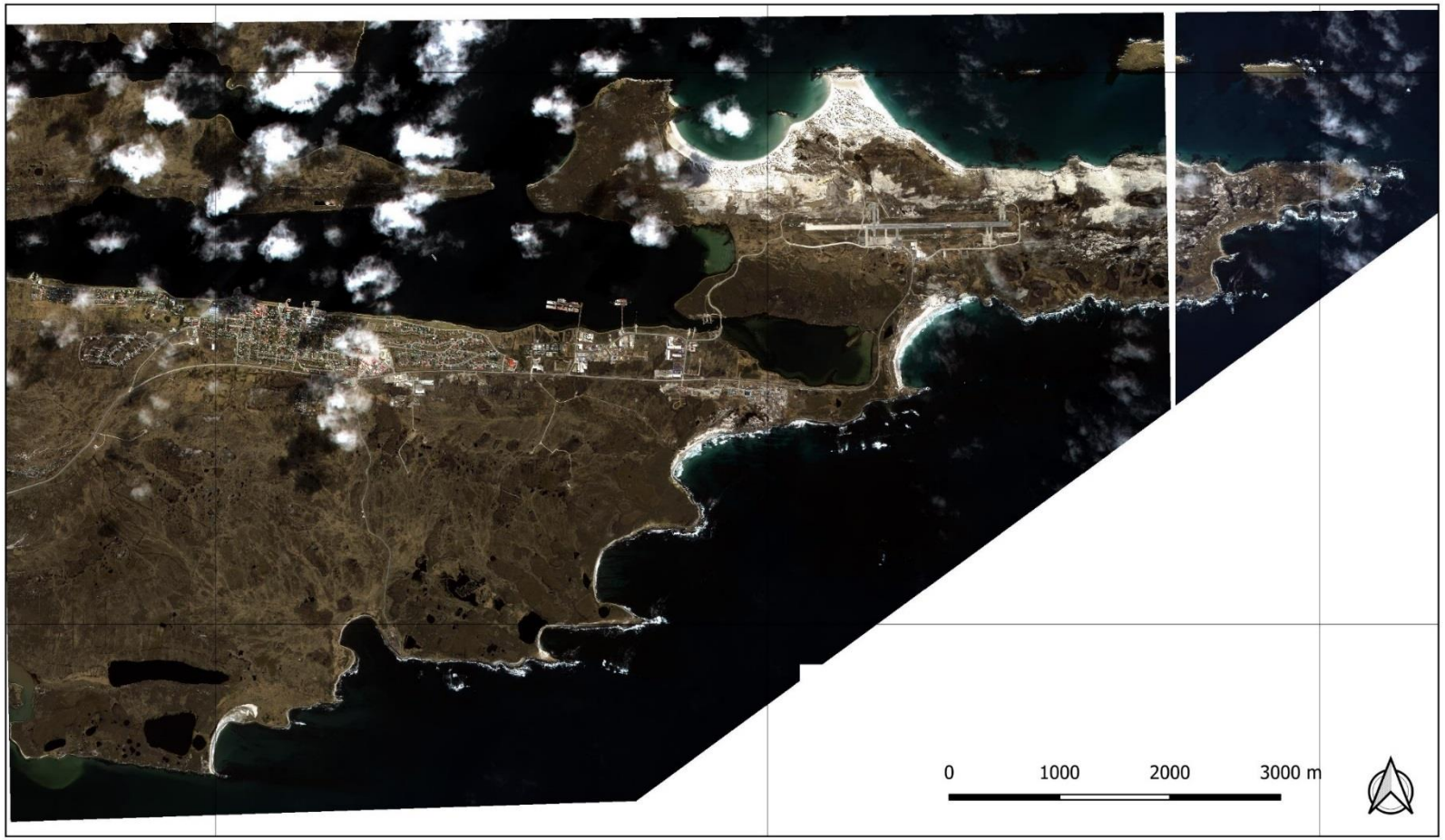
South Georgia

- Gold Head
- Grytviken
- Jason Harbour
- Fortuna Bay

WP3: Falklands fine-scale mapping priorities

Stanley Common & Cape Pembroke, East Falkland

A WorldView 2 satellite image of Stanley Common and Cape Pembroke, East Falkland, captured on XXX.
Satellite imagery courtesy of the Digital Globe Foundation.

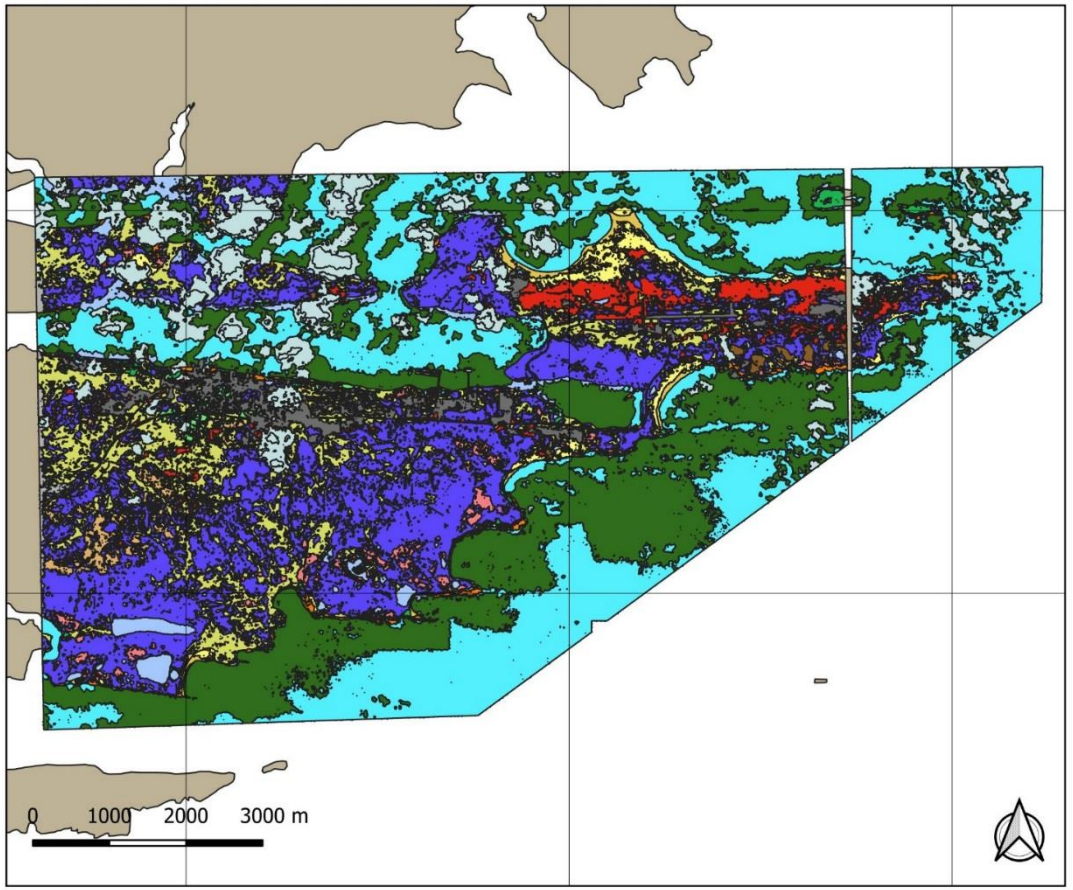


Map projection: WGS84 UTM 21S (EPSG: 32721) - Map Version 201910-01. Map created by Neil Golding.
This map was produced through the DPLUS065 Coastal Habitat Mapping project, grant aided by the Darwin Initiative through UK Government funding.

WP3: Falklands fine-scale mapping priorities

Stanley Common & Cape Pembroke, East Falkland

Fine-scale coastal habitat (Object Based Image Analysis Random Forest classification) derived from WorldView 2 satellite imagery of Stanley Common and Cape Pembroke, East Falkland. Imagery captured on XXX.
Satellite imagery courtesy of the Digital Globe Foundation.



Fine-scale habitats

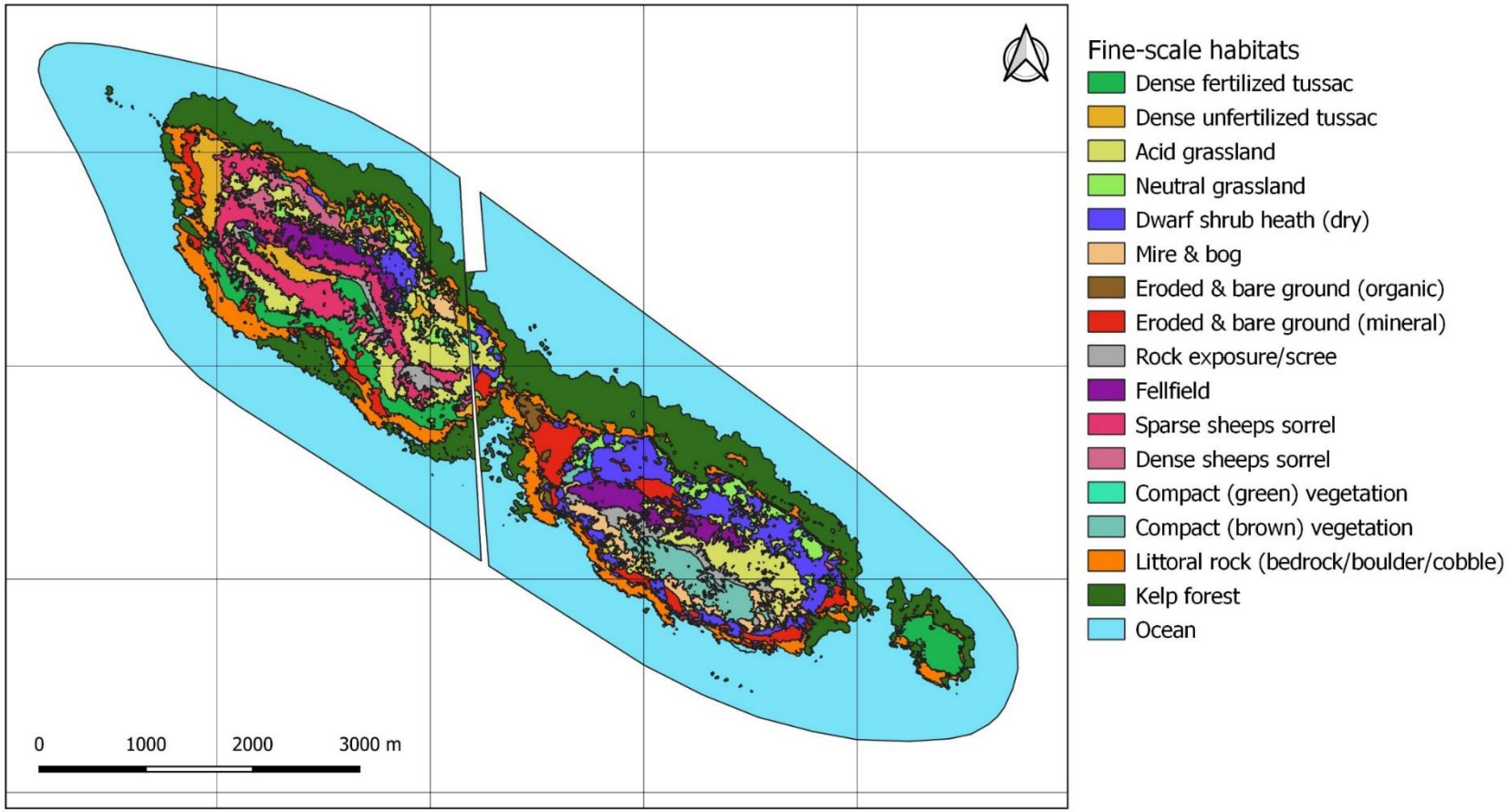
- Tussac
- Acid grassland
- Neutral grassland
- Dwarf shrub heath (dry)
- Dry dwarf shrub heath & fern bed mosaic
- Dry dwarf shrub heath, scrub & acid grassland mosaic
- Marshy grassland/Marsh/Flush
- Eroded/bare ground (mineral)
- Eroded/bare ground (organic)
- Built-up areas/Urban/Roads
- Rock exposure
- Inland water
- Ocean
- Kelp forests
- Sand dunes
- Built-up areas/Urban/Roads (cloud shadow)
- Littoral coarse sediment (pebbles/gravel/sand)
- Littoral rock
- Cloud

Map projection: WGS84 UTM 21S (EPSG: 32721) - Map Version 201910-01. Map created by Neil Golding.
This map was produced through the DPLUS065 Coastal Habitat Mapping project, grant aided by the Darwin Initiative through UK Government funding.

WP3: Falklands fine-scale mapping priorities

Steeple Jason, West Falkland

Fine-scale coastal habitat map (Object Based Image Analysis Random Forest classification) derived from WorldView 2 satellite imagery captured on November 14th, 2016.
Satellite imagery courtesy of the DigitalGlobe Foundation.



Map projection: WGS84 UTM 21S (EPSG: 32721) - Map Version 201909-01. Map created by Neil Golding.
This map was produced through the DPLUS065 Coastal Habitat Mapping project, grant aided by the Darwin Initiative through UK Government funding.

WP3: Falklands fine-scale mapping priorities

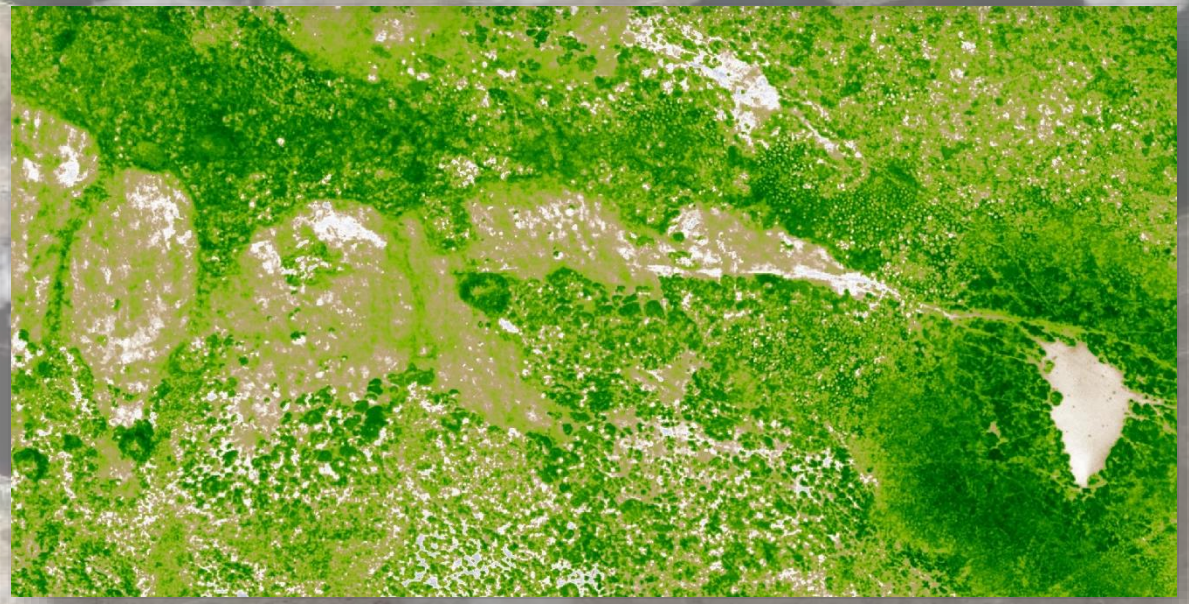
- Steeple Jason accuracy assessment
- Overall accuracy 81%

Ground Validation (Observed/Reference) points

Fine-scale Habitat Class	Littoral rock (bedrock/boulder/cobble)	Dense fertilized tussac	Kelp forest	Ocean	Surf	Eroded & bare ground (mineral)	Mire & bog	Compact (brown) vegetation	Rock exposure/scree	Acid grassland	Dwarf shrub heath (dry)	Fellfield	Neutral grassland	Dense unfertilized tussac	Eroded & bare ground (organic)	Compact (green) vegetation	Dense sheeps sorrell	Sparse sheeps sorrell		Total number of classified/predicted points	User Accurracy (%) (Reliability)
Classified / Predicted habitat classes: Littoral rock (bedrock/boulder/cobble)	14712	880	386	32	69	720	1	0	3	34	184	2	92	762	272	16	0	0		18165	81
Dense fertilized tussac	686	19736	8	1	0	1098	71	11	179	1195	436	5	211	1812	17	440	254	142		26302	75
Kelp forest	1882	63	21932	311	11	2	0	0	11	0	0	0	0	7	0	0	0	0		24219	91
Ocean	440	2	493	62054	7	0	5	1	38	0	0	0	0	1	0	0	0	1		63042	98
Surf	634	3	17	96	442	1	0	0	2	1	0	0	0	0	0	0	0	0		1196	37
Eroded & bare ground (mineral)	999	115	0	0	0	13491	0	0	6	42	74	330	396	280	38	2	0	0		15773	86
Mire & bog	2	70	1	2	0	8	2396	411	174	898	401	14	4	167	0	1	8	71		4628	52
Compact (brown) vegetation	17	6	0	2	0	4	679	6772	191	77	29	1	0	104	169	0	1	18		8070	84
Rock exposure/scree	0	43	0	22	0	65	248	32	6468	582	0	381	0	742	0	0	37	853		9473	68
Acid grassland	19	410	0	0	0	7	447	114	462	14792	816	890	403	189	0	227	910	1164		20850	71
Dwarf shrub heath (dry)	237	389	0	0	0	80	396	0	0	833	11890	52	333	602	70	528	32	102		15544	76
Fellfield	8	0	0	0	0	137	51	8	642	1227	51	10448	14	240	0	0	9	1147		13982	75
Neutral grassland	503	134	0	0	0	525	19	0	0	673	269	38	732	572	24	190	33	36		3748	20
Dense unfertilized tussac	449	1865	1	0	0	87	110	2	64	484	501	22	202	5125	37	21	108	300		9378	55
Eroded & bare ground (organic)	100	1	0	2	0	0	0	0	0	2	8	0	0	75	3312	1	0	0		3501	95
Compact (green) vegetation	3	8	0	0	0	0	2	0	0	2	64	0	7	1	0	260	0	2		349	74
Dense sheeps sorrell	3	90	1	0	1	14	2	0	111	459	58	5	26	87	2	28	4113	1256		6256	66
Sparse sheeps sorrell	6	63	0	0	0	69	15	31	996	1476	22	1341	3	366	0	8	1171	14845		20412	73
Total number of ground validation points	20700	23878	22839	62522	530	16308	4442	7382	9347	22777	14803	13529	2423	11132	3941	1722	6676	19937			
Producers Accuracy (%)	71	83	96	99	83	83	54	92	69	65	80	77	30	46	84	15	62	74			

Kappa	0.78
Overall Accuracy	81%

WP3: Falklands fine-scale mapping priorities



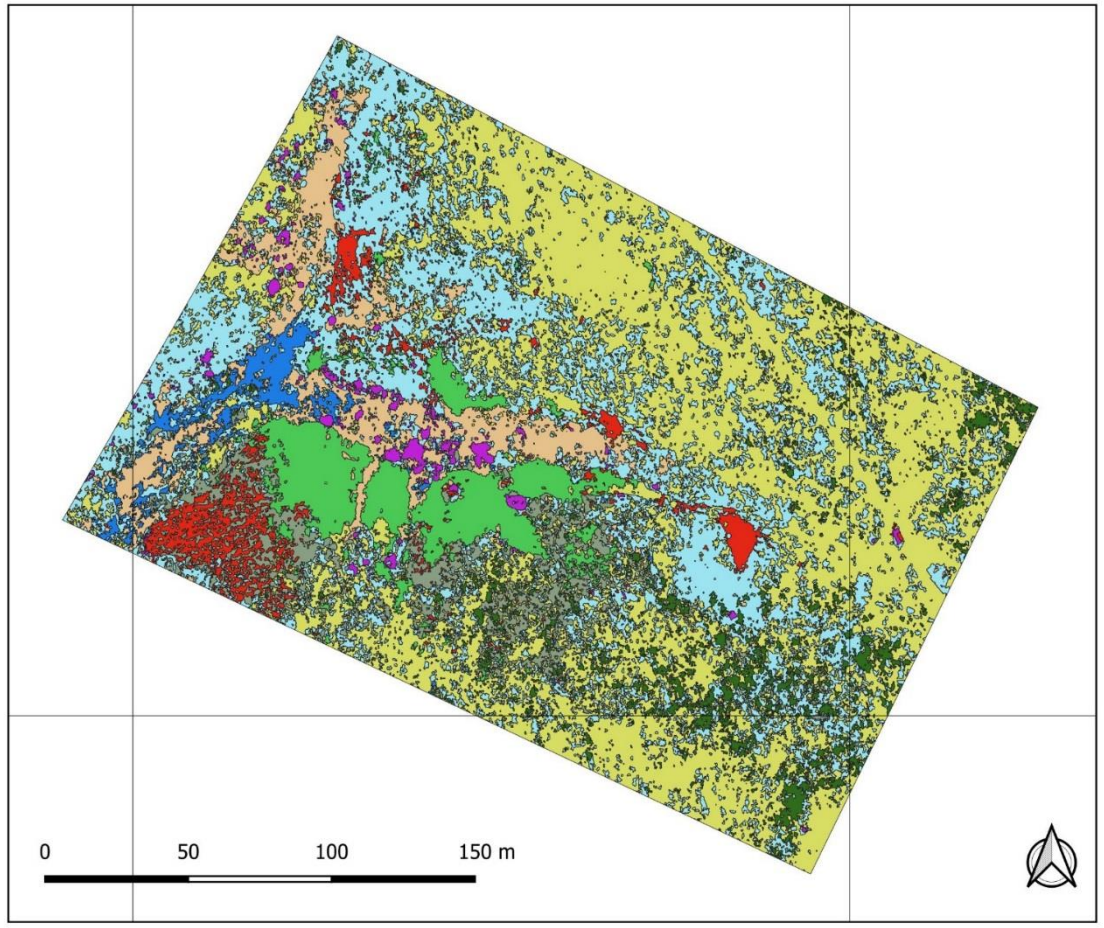
Port Sussex – calafate mapping

Use of multispectral imagery – NDVI

WP3: Falklands fine-scale mapping priorities

Port Sussex, East Falkland

Pilot study area for calafate mapping. Fine-scale coastal habitat map (Object Based Image Analysis Random Forest classification) derived from drone imagery flown at 30m Above Ground Level (AGL)



Fine-scale habitats

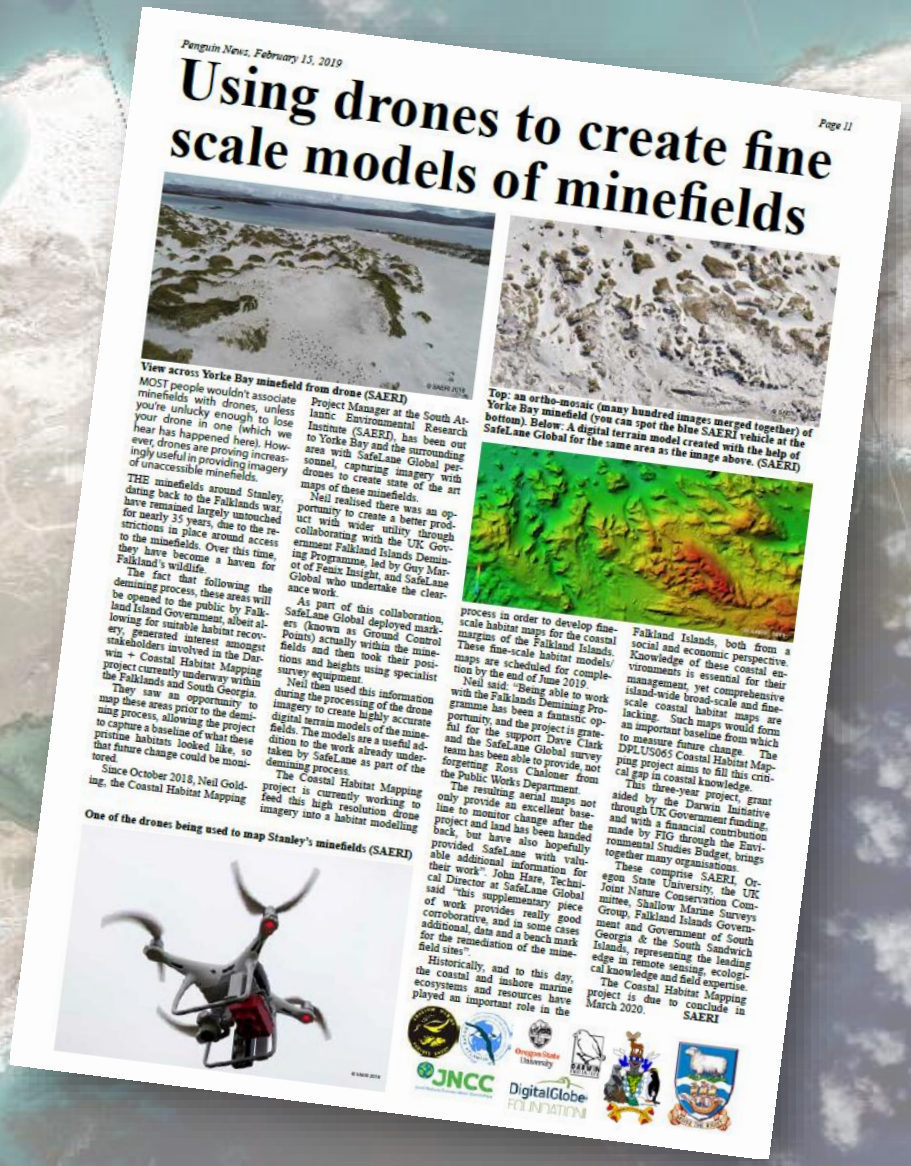
- Acid grassland
- Modified grassland
- Mosaic of moss & short mixed grassland
- Dwarf shrub heath/Acid grassland mosaic
- Dwarf shrub heath
- Fern beds with exposed/bare ground (organic)
- Cushion heath
- Flush
- Calafate
- Eroded/bare ground (mineral)

Map projection: WGS84 UTM 21S (EPSG: 32721) - Map Version 201908-01. Map created by Neil Golding.

This map was produced through the DPLUS065 Coastal Habitat Mapping project, grant aided by the Darwin Initiative through UK Government funding.

WP3: Falklands fine-scale mapping priorities

- York Bay minefields – FIG priority
- Collaboration with SafeLane Global & UK Foreign & Commonwealth Office



Penguin News, February 15, 2019 — Page 11

Using drones to create fine scale models of minefields

View across Yorke Bay minefield from drone (SAERI)

Top: an ortho-mosaic (many hundred images merged together) of Yorke Bay minefield (you can spot the blue SAERI vehicle at the bottom). Below: A digital terrain model created with the help of SafeLane Global for the same area as the image above. (SAERI)

MOST people wouldn't associate minefields with drones, unless you're unlucky enough to lose your drone in one (which we hear has happened here). However drones are proving increasingly useful in providing imagery of unaccessible minefields.

THE minefields around Stanley, dating back to the Falklands war, have remained largely untouched for nearly 35 years, due to the restrictions in place around access to the minefields. Over this time, they have become a haven for Falkland's wildlife.

The fact that following the demining process, these areas will be opened to the public by Falkland Island Government, albeit allowing for suitable habitat recovery, generated interest amongst stakeholders involved in the Darwin + Coastal Habitat Mapping project currently underway within the Falklands and South Georgia.

They saw an opportunity to map these areas prior to the demining process, allowing the project to capture a baseline of what these pristine habitats looked like, so that future change could be monitored.

Since October 2018, Neil Golding, the Coastal Habitat Mapping Project Manager at the South Atlantic Environmental Research Institute (SAERI), has been out to Yorke Bay and the surrounding area with SafeLane Global personnel, capturing imagery with drones to create state of the art maps of these minefields.

Neil realised there was an opportunity to create a better product with wider utility through collaborating with the UK Government Falkland Islands Demining Programme, led by Grey Martin of Fenix Insight, and SafeLane Global who undertake the clearance work.

As part of this collaboration, SafeLane Global deployed markers (known as Ground Control Points) actually within the minefields and then took their positions and heights using specialist survey equipment.

Neil then used this information during the processing of the drone imagery to create highly accurate digital terrain models of the minefields. The models are a useful addition to the work already undertaken by SafeLane as part of the demining process.

The Coastal Habitat Mapping project is currently working to feed this high resolution drone imagery into a habitat modelling process in order to develop fine-scale habitat maps for the coastal margins of the Falkland Islands. These fine-scale habitat models/maps are scheduled for completion by the end of June 2019.

Neil said: "Being able to work with the Falklands Demining Programme has been a fantastic opportunity, and the project is grateful for the support Dave Clark and the SafeLane Global survey team has been able to provide, not forgetting Ross Chaloner from the Public Works Department.

The resulting aerial maps not only provide an excellent baseline to monitor change after the project and land has been handed back, but have also hopefully provided SafeLane with valuable additional information for their work". John Hare, Technical Director at SafeLane Global said: "this supplementary piece of work provides really good corroborative, and in some cases additional, data and a bench mark for the remediation of the minefield sites".

Historically, and to this day, the coastal and inshore marine ecosystems and resources have played an important role in the Falkland Islands, both from a social and economic perspective. Knowledge of these coastal environments is essential for their management, yet comprehensive island-wide broad-scale and fine-scale coastal habitat maps are lacking. Such maps would form an important baseline from which to measure future change. The DPLUS065 Coastal Habitat Mapping project aims to fill this critical gap in coastal knowledge.

This three-year project, grant aided by the Darwin Initiative through UK Government funding, and with a financial contribution made by FIG through the Environmental Studies Budget, brings together many organisations. These comprise SAERI, Oregon State University, the UK Joint Nature Conservation Committee, Shallow Marine Surveys Group, Falkland Islands Government and Government of South Georgia & the South Sandwich Islands, representing the leading edge in remote sensing, ecological knowledge and field expertise.

The Coastal Habitat Mapping project is due to conclude in March 2020.

SAERI

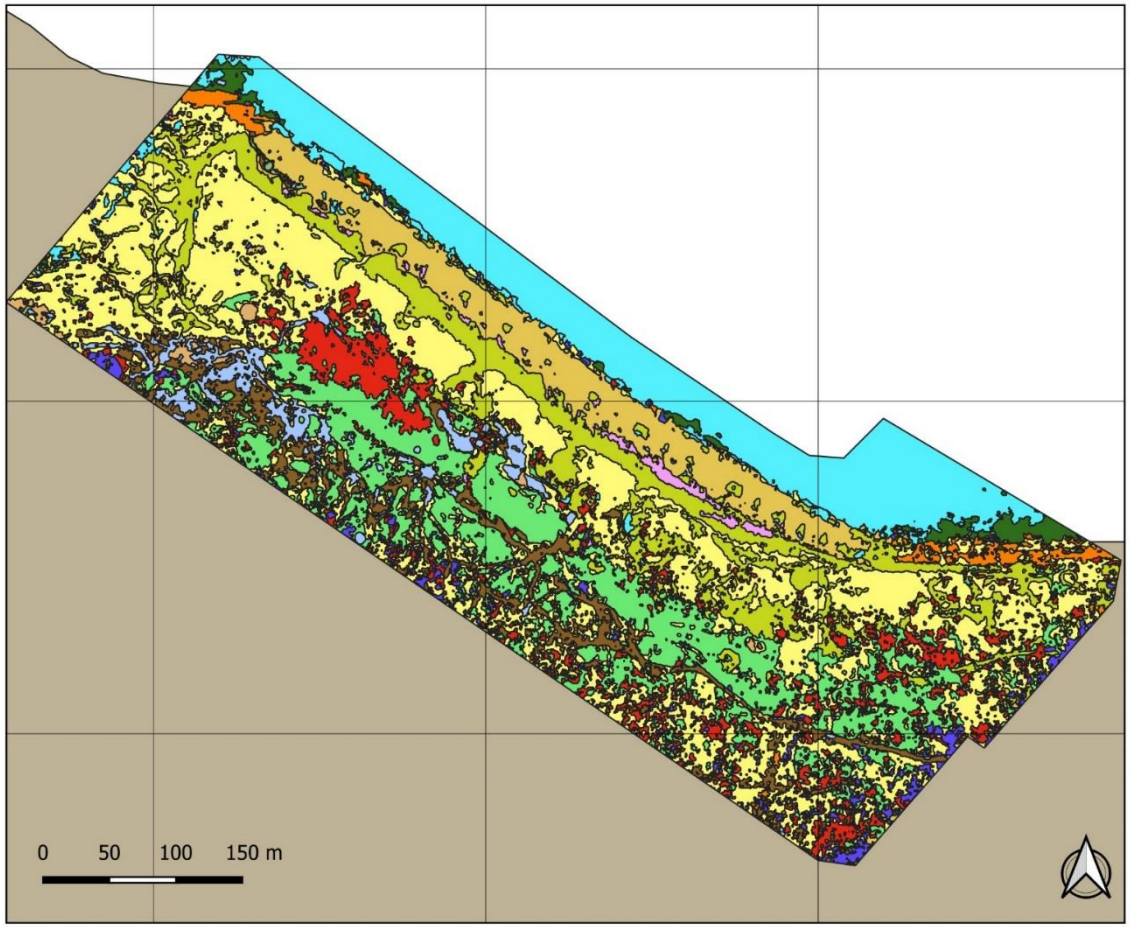
One of the drones being used to map Stanley's minefields (SAERI)

SAFELANE GLOBAL

WP3: Falklands fine-scale mapping priorities

Minefield 7, East Falkland

Fine-scale coastal habitat map (Object Based Image Analysis Random Forest classification) derived from drone imagery flown at 50m Above Ground Level (AGL)



Fine-scale habitats

- Dwarf shrub heath (dry)
- Marsh/marshy grassland
- Inland water / standing water
- Littoral rock (bedrock/boulder/cobble)
- Sand dunes (with marram grass)
- Kelp forests
- Ocean
- Littoral coarse sediment (LCS) [wet]
- Vehicles
- Krill tideline remnants
- Short mixed grassland
- Wet/muddy ground
- Strandline kelp
- Sand dunes (little/no marram grass) & LCS [dry]
- Dense marram grass

Map projection: WGS84 UTM 21S (EPSG: 32721) - Map Version 201910-01. Map created by Neil Golding.

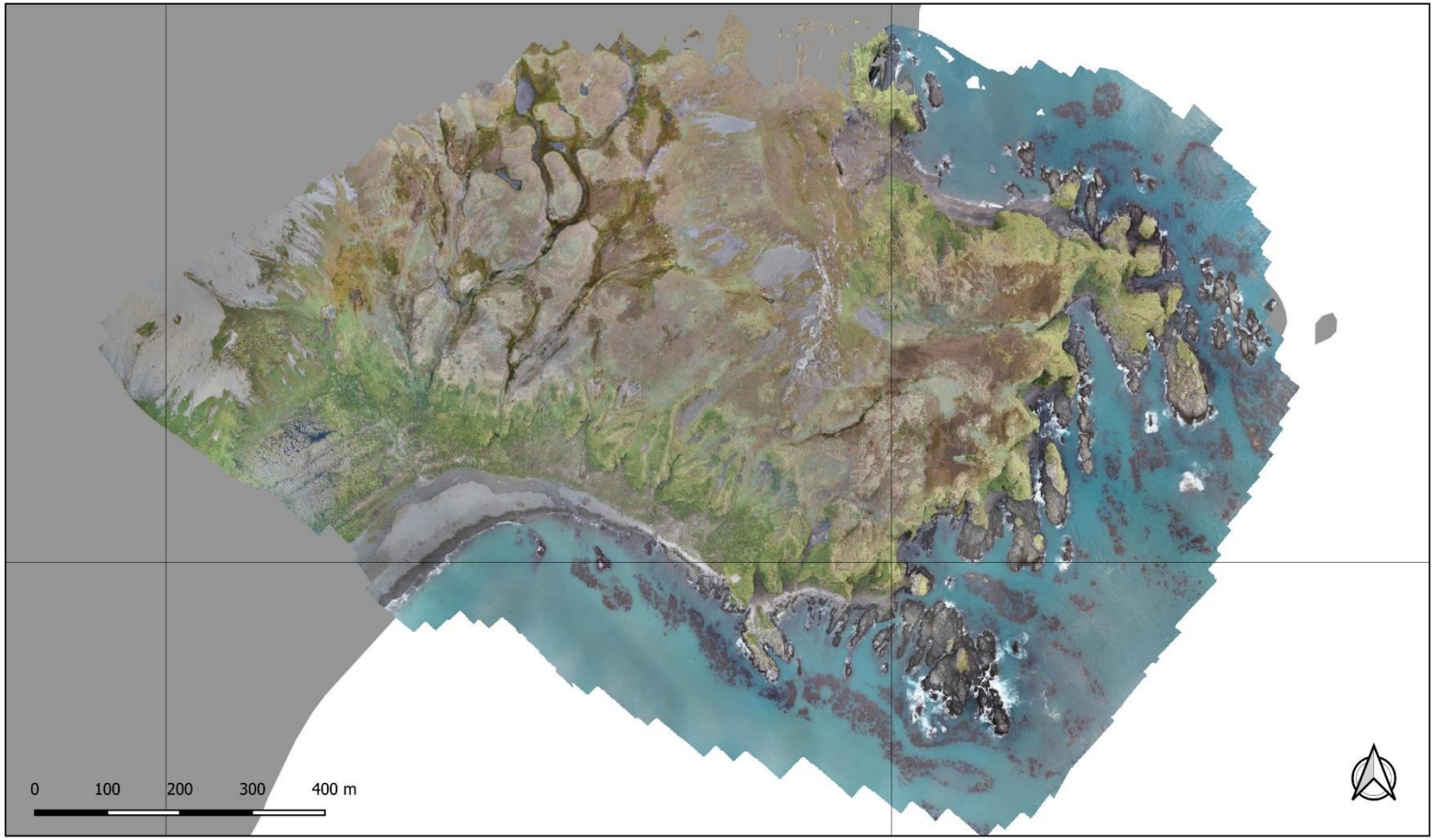
This map was produced through the DPLUS065 Coastal Habitat Mapping project, grant aided by the Darwin Initiative through UK Government funding.

Rookery Bay minefield: post de-mining

WP3: South Georgia fine-scale mapping priorities

Gold Head, South Georgia

An aerial imagery orthomosaic generated from a 100m AGL drone mapping mission flown on 9th March 2019



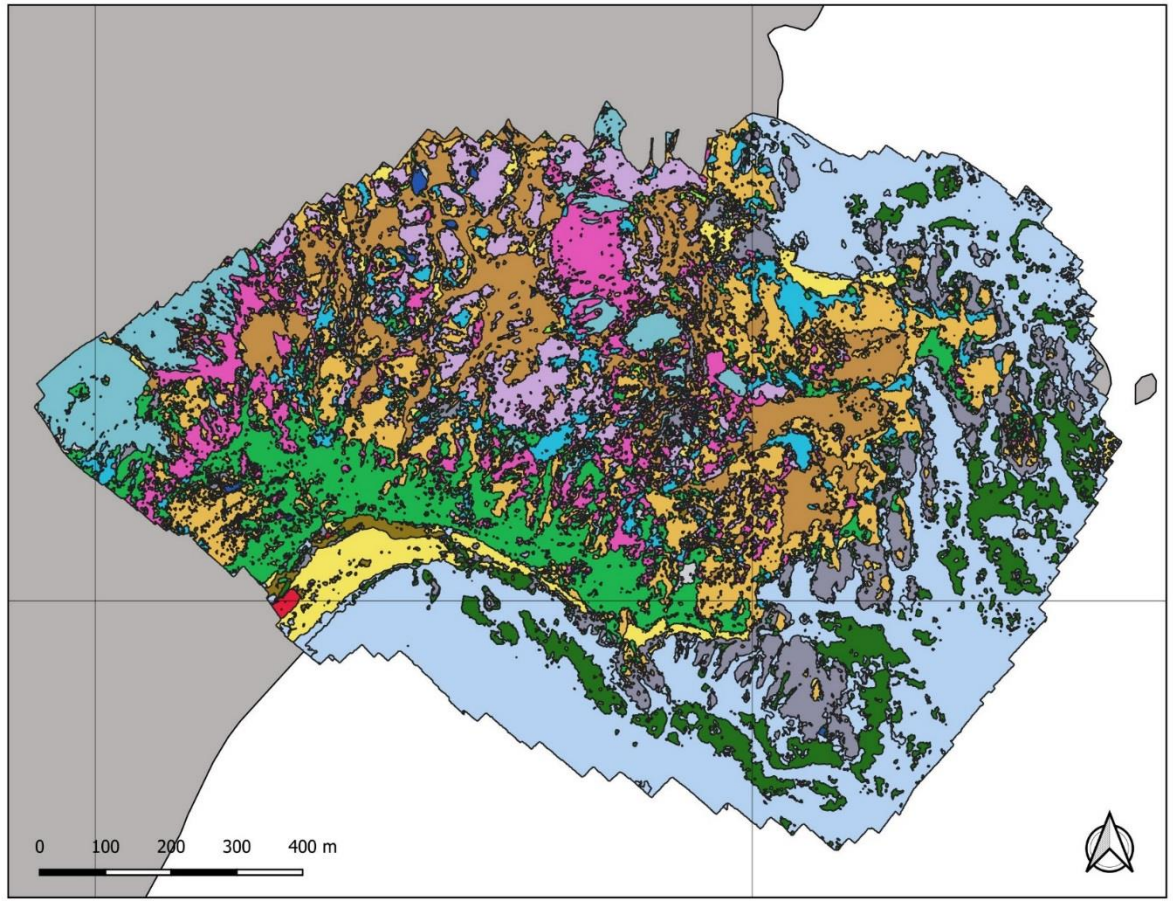
Map projection: WGS84 South Georgia Lambert (EPSG: 3762) - Map Version 201909-01. Map created by Neil Golding.
This imagery was collected through the DPLUS065 Coastal Habitat Mapping project, grant aided by the Darwin Initiative through UK Government funding. © SAERI, 2019

Satellite images courtesy of Digital Globe Foundation

WP3: South Georgia fine-scale mapping priorities

Gold Head, South Georgia

Fine-scale coastal habitat map (Object Based Image Analysis Random Forest classification)
Derived from drone imagery flown at 100 AGL



Fine-scale habitats

- Dense fertilized tussac
- Dense unfertilized tussac
- Festuca grassland
- Short mixed grassland
- Sparse lowland fellfield-like
- Mire and bog
- Acaena herbfield
- Littoral coarse sediment (pebble/gravel/sand)
- Rock exposure
- Bare ground (mineral)
- Inland water
- Kelp beds
- Penguin colony
- Moss-dominated communities
- Stream bed (sandy)
- Ocean

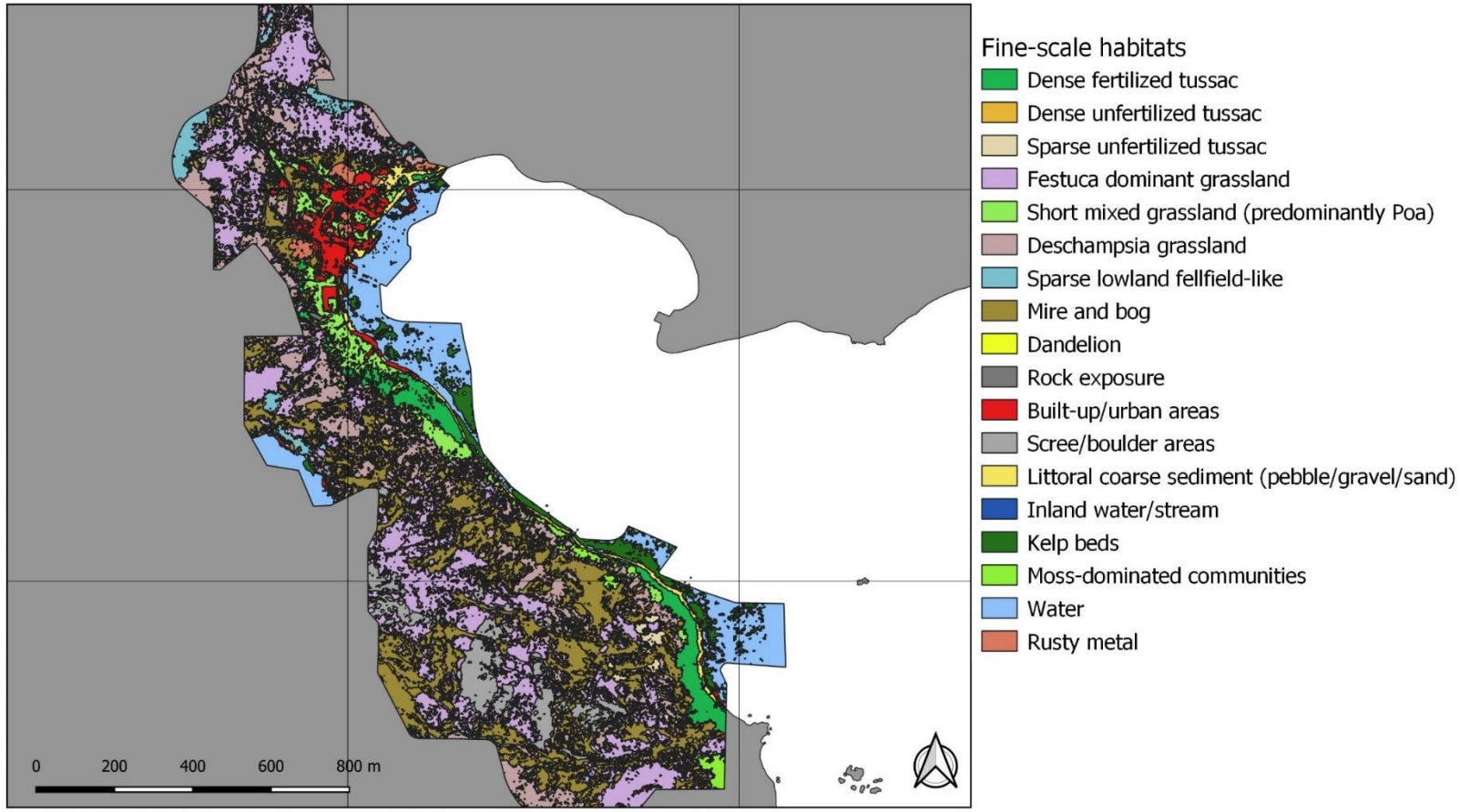
Map projection: WGS84 South Georgia Lambert (EPSG: 3762) - Map Version 201909-01. Map created by Neil Golding.
This map was produced through the DPLUS065 Coastal Habitat Mapping project, grant aided by the Darwin Initiative through UK Government funding.

Satellite images courtesy of Digital Globe Foundation

WP3: South Georgia fine-scale mapping priorities

Grytviken, South Georgia

Fine-scale coastal habitat map (Object Based Image Analysis Random Forest classification) derived from drone imagery. Drone mission carried out by Geometria Ltd in April 2018 for the Government of South Georgia & the South Sandwich Islands.



Map projection: WGS84 South Georgia Lambert (EPSG: 3762) - Map Version 201909-01. Map created by Neil Golding.
This imagery was collected by Geometria Ltd on behalf of the Government of South Georgia & the South Sandwich Islands. © GSGSSI, 2018

Satellite images courtesy of Digital Globe Foundation

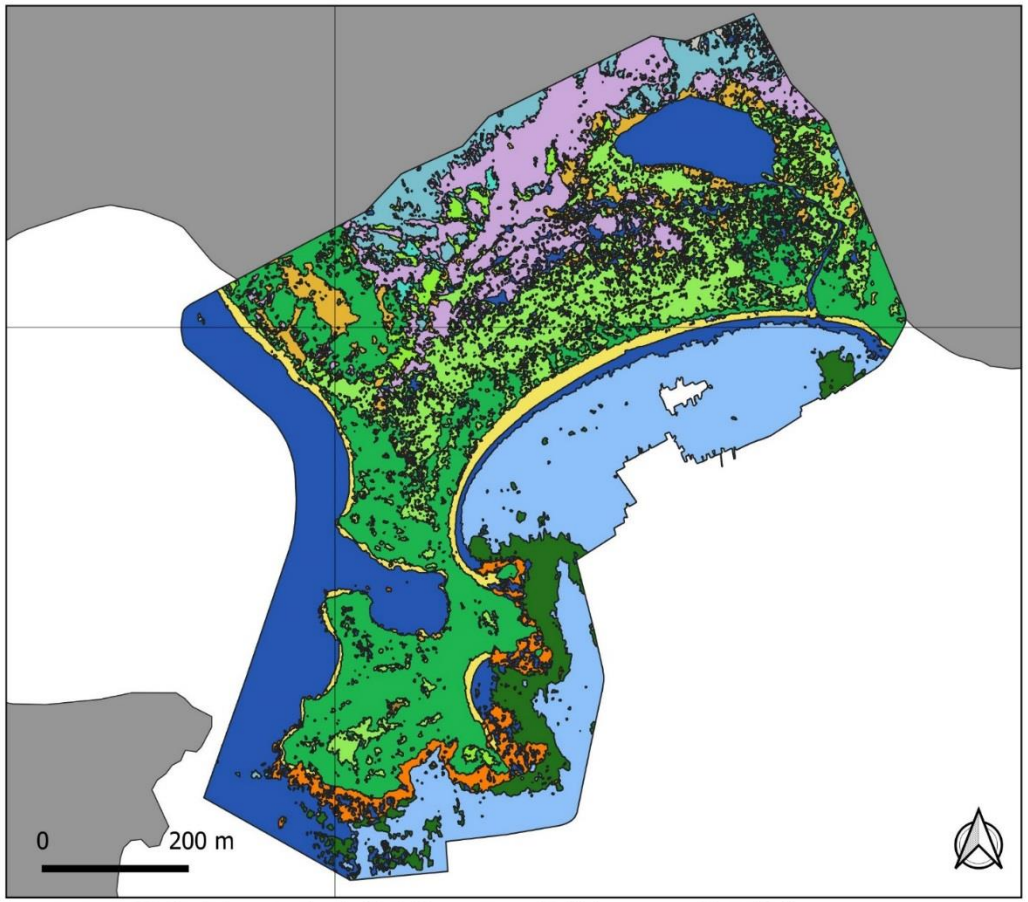
WP3: South Georgia fine-scale mapping priorities

Jason Harbour

WP3: South Georgia fine-scale mapping priorities

Jason Harbour, South Georgia

Fine-scale coastal habitat map (Object Based Image Analysis Random Forest classification)
Derived from drone imagery flown at 100m Above Ground Level (AGL)



Fine-scale habitats
- Tussac
- Festuca dominant grassland
- Deschampsia dominant grassland
- Short mixed grassland (predominantly Poa)
- Sparse lowland fellfield-like
- Mire and bog
- Acaena herbfield communities
- Moss-dominated communities
- Rock exposure
- Littoral rock (bedrock/boulder/cobble)
- Littoral coarse sediment (pebble/gravel/sand)
- Bare/exposed ground (organic)
- Water (high sediment load)
- Water (low sediment load)
- Kelp beds

Map projection: WGS84 South Georgia Lambert (EPSG: 3762) - Map Version 201908-01. Map created by Neil Golding.
This map was produced through the DPLUS065 Coastal Habitat Mapping project, grant aided by the Darwin Initiative through UK Government funding.

Satellite images courtesy of Digital Globe Foundation

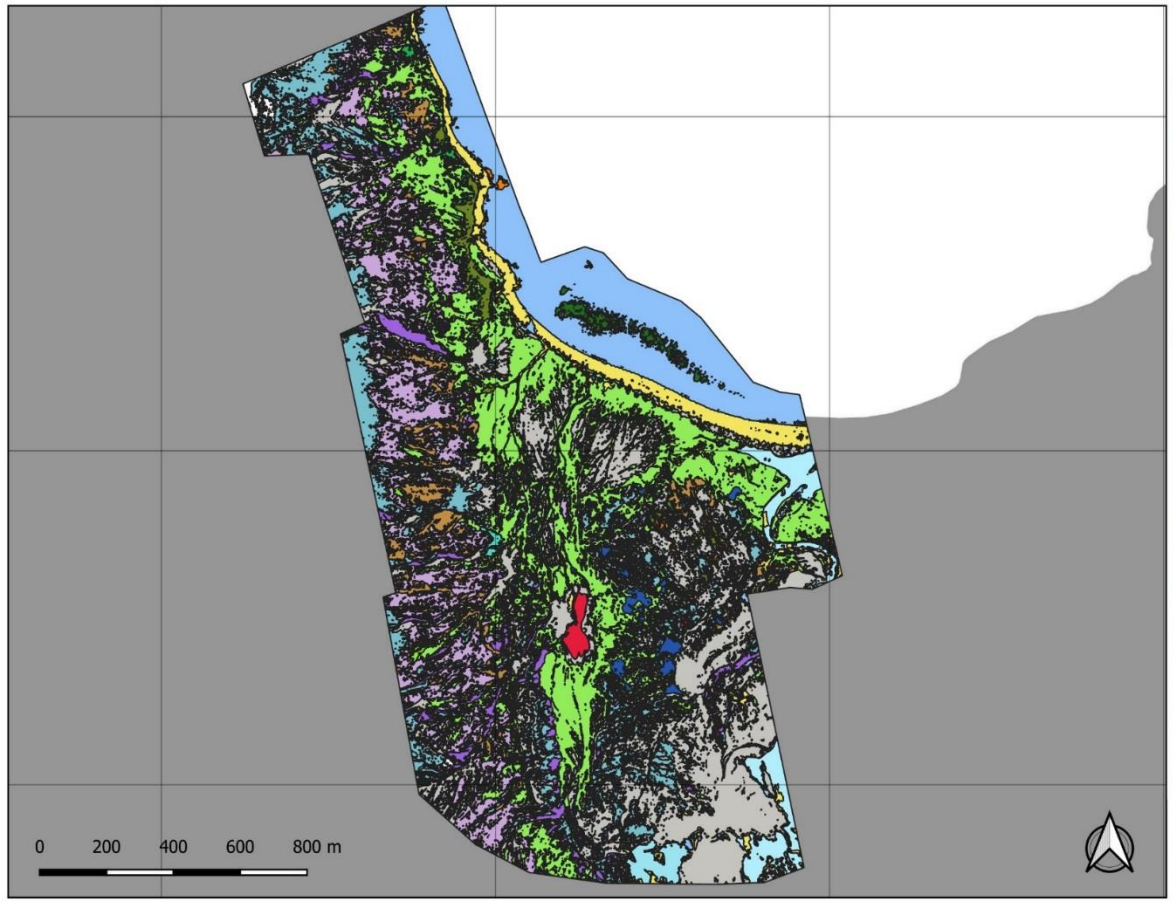
WP3: South Georgia fine-scale mapping priorities

Fortuna Bay

WP3: South Georgia fine-scale mapping priorities

Fortuna Bay, South Georgia

Fine-scale coastal habitat map (Object Based Image Analysis Random Forest classification)
Derived from drone imagery flown at 100 AGL



Fine-scale habitats

- Dense fertilized tussac
- Dense unfertilized tussac
- Seal-impacted tussac
- Festuca grassland
- Short mixed grassland
- Sparse lowland fellfield-like
- Mire and bog
- Acaena herbfield
- Recently exposed glacial deposits
- Bare ground (mineral)
- Snow/ice
- Littoral rock (bedrock/boulder/cobble)
- Littoral coarse sediment (pebble/gravel/sand)
- Inland water
- Kelp beds
- Ocean
- Moss-dominated communities
- King penguin colony
- Glacial water
- Sparse vegetation

Map projection: WGS84 South Georgia Lambert (EPSG: 3762) - Map Version 201909-01. Map created by Neil Golding.
This map was produced through the DPLUS065 Coastal Habitat Mapping project, grant aided by the Darwin Initiative through UK Government funding.

Satellite images courtesy of Digital Globe Foundation

2019 South Georgia Archaeological Project

- Led by SGHT, SGA & Cambridge University
- Coastal Mapping Project supported the archaeological fieldwork
- Collected data for the Coastal Habitat Mapping Project
- Importance of collaboration / vessels of opportunity
- Valuable support from Iridium Comms & MailASail

UNIVERSITY OF CAMBRIDGE

The Gino Watkins Memorial Fund

NATIONAL GEOGRAPHIC

SHACKLETON

iridium

CAMBRIDGE ARCHAEOLOGICAL UNIT

South Georgia Association

friends of South Georgia ISLAND

mailasail satellite communications

South Georgia HERITAGE TRUST

South Georgia Archaeological Project

McDonald Institute for Archaeological Research

Satellite images courtesy of Digital Globe Foundation

South Georgia: Ground validation & drone imagery

Penguin News, April 3, 2019 — Page 11

The view across Gold Harbour. Copyright: SAERI 2019

A composite image of Bird Island. Copyright: SAERI 2019

Using drones to map South Georgia's coastal habitats

THE recent South Georgia Archeological Project expedition to South Georgia (see centre spread) included Neil Golding of the South Atlantic Environmental Research Institute (SAERI), project manager for the Institute's ongoing Darwin Plus Coastal Habitat Mapping.

The aim of the trip for this project, Neil told Penguin News, was to reach areas identified by the project's stakeholders as priority areas, that is to say, areas where the stakeholders wanted "much more detailed information than they got from the broad-scale maps originally developed through the project for South Georgia."

Those areas include popular visitor sites, which will provide a useful tool to help better inform their management, he said.

But the detailed imagery and consequent mapping will also provide a valuable baseline into how habitats and the island's vegetation are changing and developing in the wake of the successful eradication of rodents and reindeer from South Georgia.

The trip allowed the project to add 241 points of ground validation data into the model, in other words, checking the broad-scale habitat model predictions against the reality on the island's surface.

The use of a drone further allowed Neil to obtain detailed imagery of eight locations within South Georgia: Bird Island, Elsehul, Koppen Point, Jason Harbour, Starr Point (Salisbury Plain), Fortuna Bay, Albatross Cove (Cooper Bay) and Gold Harbour. From this imagery, he says, we can then interrogate to compare with what is predicted on the broad-scale maps, but also it gives us that much higher level of resolution about what's on the ground; [and helps with] species counts, so we've got a really good data-set from Fortuna Bay, which has a large colony of king penguins.

The drone imagery, together with high res World View satellite imagery from the Digital Globe Foundation, will result in "more robust fine-scale habitat maps" for the project was grateful for the support they received from Iridium Communications.

Neil also supported the archaeological project, providing invaluable aerial footage of dig sites, allowing "archaeologists to put those sites in the context of the wider environment."

The Coastal Habitat Mapping Project aims to develop the first island-wide broad-scale and fine-scale habitat maps of the coastal margin for South Georgia and the Falklands.

The project is led by SAERI with the Government of South Georgia and South Sandwich Islands as an integral partner, and further partner support from the Falkland Islands Government, Oregon State University, the UK Joint Nature Conservation Committee (JNCC), and the Shallow Marine Surveys Group.

The drone used in the project. Pic: N Golding Copyright: SAERI 2019

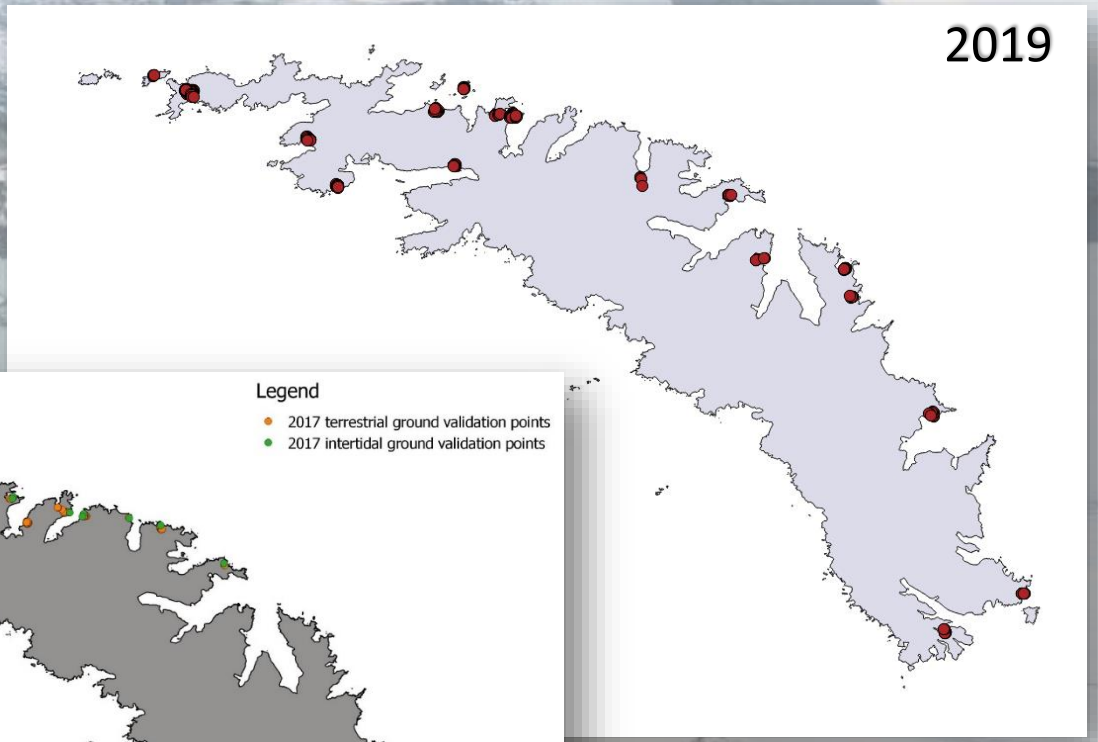
Falkland Islands Obesity Awareness Day – 2019

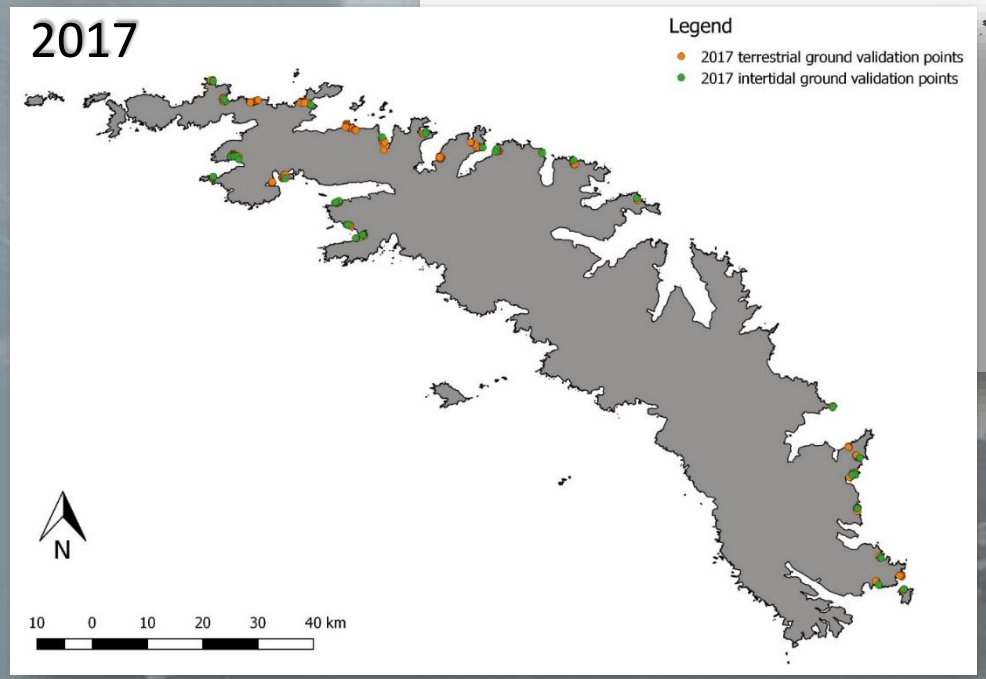
To observe World Health Day held annually on 07th April, KEMH is organising a "Falkland Islands Obesity Awareness Day"

Everyone is invited to attend to have their Body Mass Index (BMI), Blood Pressure (BP) and Blood Sugar checked.

When? - Monday 08th April 2019 between 10:00am and 12:00 noon and 1:00pm and 4:00pm

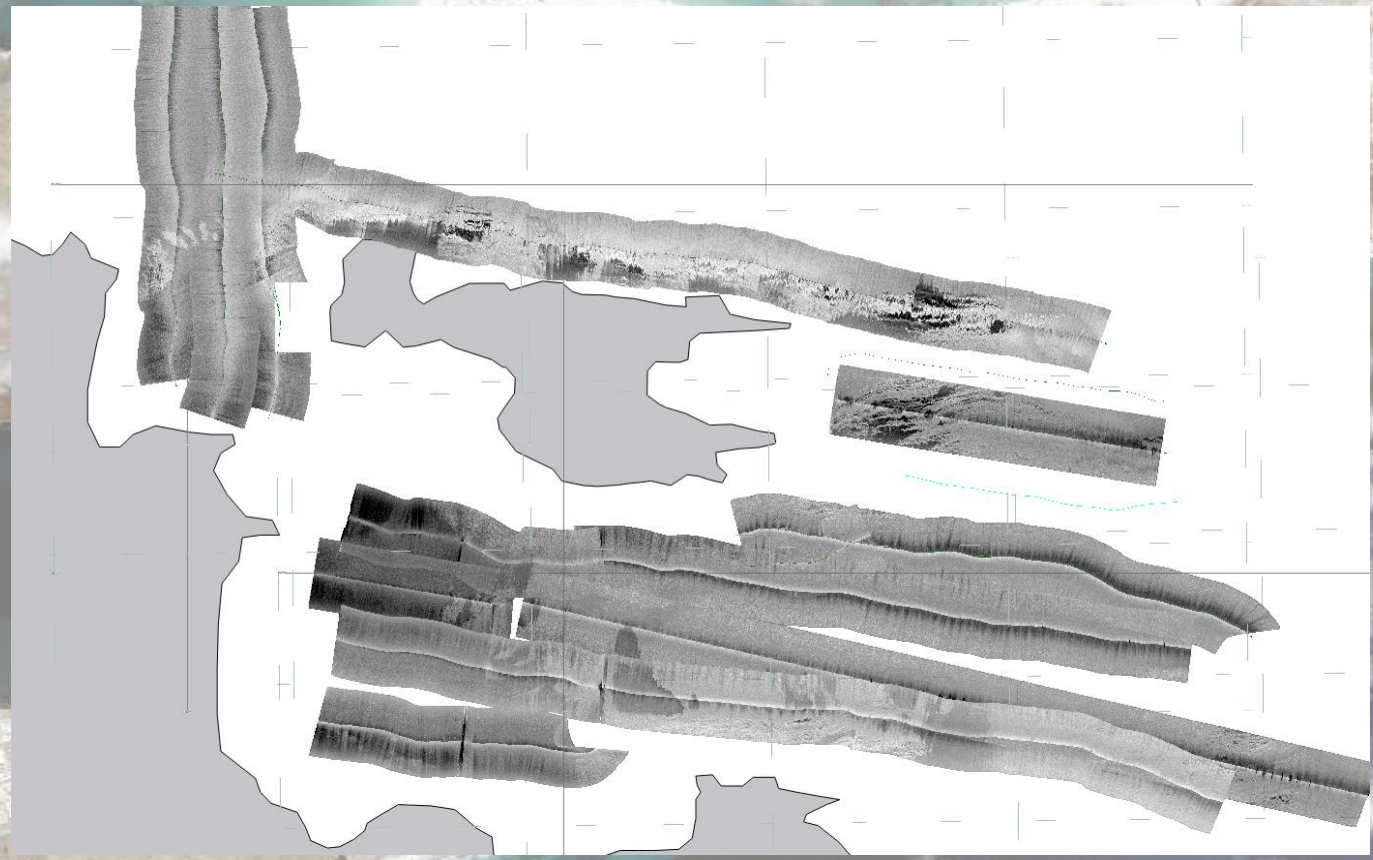
Where? - Book in at KEMH Reception and you will be called through to see the Practice Nurse





Two expeditions to South Georgia: Nov/Dec '17 & Feb/March '19

WP3: Fine-scale mapping priorities - subtidal



WP3 – Fine-scale habitat mapping

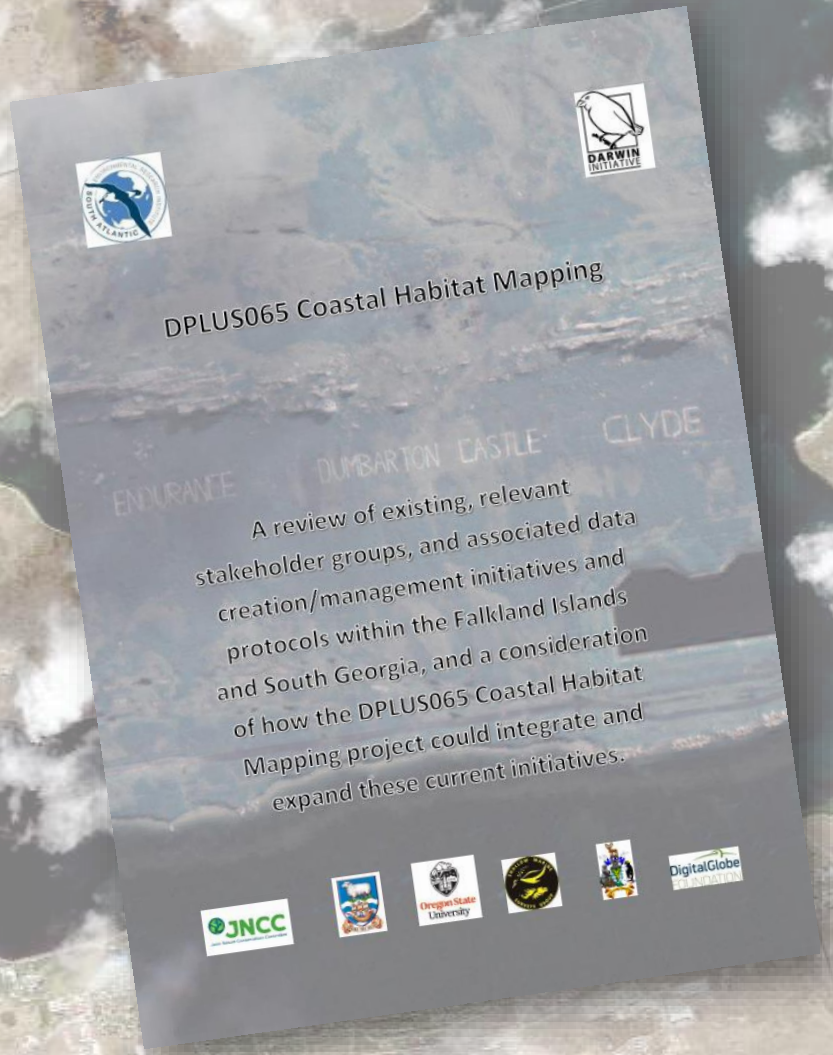
- Mapping and data collection has been undertaken in a variety of other locations across the Falklands & South Georgia.

- Huge range of project applications, through collaborations and new partnerships - explored further after lunch.

WP4 – Prioritisation of ongoing planning/protection/monitoring

- Training workshop – part of the project legacy – explored by Gwawr later…
- Development of a long-term coastal mapping/monitoring manual (protocols/methods)

WP5 – Project outputs integrated with existing/emerging initiatives



- Review of relevant, existing data creation/management initiatives and protocols within the Falkland Islands and South Georgia
- Consideration of how the DPLUS065 Coastal Habitat Mapping project could integrate and expand these current initiatives

WP5 – Project outputs integrated with existing/emerging initiatives

- End of project workshop – developing ideas for using existing/innovating new spatial tools for conservation planning & land management in remote areas.

WP5 – Project outputs integrated with existing/emerging initiatives

- End of project workshop – developing ideas for using existing/innovating new spatial tools for conservation planning & land management in remote areas.

…TODAY…

Additional outputs

- Improved environmental baseline for the Falklands & South Georgia
- Better understanding of habitat/species distribution e.g. giant kelp
- Knowledge transfer to the wider community
- Greater awareness through education: FC Watch Group/ IJS Marine Forests / Shackleton Scholar
- Framework and tools for future habitat model updates (e.g. smartphone app.)

Spatial tools for conservation planning in remote spaces: end of project workshop

Any questions?

DPLUS065 Coastal Mapping Project – Grant aided by the Darwin Initiative through UK Government funding - Satellite image courtesy of Digital Globe Foundation