



Darwin Plus (DPLUS 065) Mapping the Falklands & South Georgia coastal margins for spatial planning (Coastal Mapping)

Darwin Plus: 2018 Annual Report



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Cover image top: *View across Yorke Bay minefield, Cape Pembroke, East Falkland. Photo Credit: Neil Golding © SAERI, 2018*

Cover image bottom: *Bird Island, South Georgia, as mapped by the DPLUS065 Coastal Habitat Mapping project. © SAERI, 2019*

Darwin Plus: Overseas Territories Environment and Climate Fund Annual Report

Important note *To be completed with reference to the Reporting Guidance Notes for Project Leaders:
it is expected that this report will be about 10 pages in length, excluding annexes*

Submission Deadline: 30th April 2018

Darwin Plus Project Information

Project reference	DPLUS065
Project title	Mapping Falklands and South Georgia coastal margins for spatial planning
Territory(ies)	Falkland Islands, South Georgia
Contract holder institution	SAERI
Partner institutions	Oregon State University (OSU), Joint Nature Conservation Committee (JNCC), Shallow Marine Surveys Group Ltd (SMSG), Falkland Islands Government (FIG), Government of South Georgia & the South Sandwich Islands (GSGSSI).
Grant value	£278,696
Start/end date of project	April 2017 – March 2020
Reporting period (e.g., Apr 2017-Mar 2018) and number (e.g., AR 1,2)	1 st April 2017 – 31 st March 2018
Project leader name	Dr Paul Brickle
Project website/blog/Twitter	http://www.south-atlantic-research.org/research/terrestrial-science/coastal-mapping-project/ #SouthAtlanticCoastalMapping @SAERI_FI (Twitter) @S4ERI (Facebook)
Report author(s) and date	Neil Golding & Bran Black – 25 th April 2018

2. Project overview

The coastal and inshore marine ecosystems and resources of the Falkland Islands and South Georgia (**Figure 1.1**) play an important role in these two United Kingdom Overseas Territories. From their historical role as a safe harbour, source of food, and forage for livestock, to their present importance for fishing and wildlife-based tourism revenues, these islands are defined by the diverse range of ecosystem services provided by the coast and the sea. Knowledge of these coastal environments is essential for their effective conservation and management, and yet they have been subject to little regional study. In summary, comprehensive island wide broad scale and fine scale coastal habitat maps, which would form an important baseline (from which to measure future change for example), are lacking. This project aims to fill this critical gap in coastal knowledge.

This project seeks to use freely available Earth Observation (EO) data (primarily in the form of Sentinel-2 medium resolution satellite imagery) along with other relevant data layers to develop broad scale (Stage 1) coastal habitat (land cover) maps, using machine learning techniques on the Google Earth Engine platform. Where there are significant uncertainties in habitat classifications, or where stakeholders deem it a priority (from a spatial and/or temporal perspective), fine scale (Stage 2) coastal habitat maps will be developed. These will be based on very high resolution satellite imagery (e.g. World View 2-4) or very high resolution aerial imagery gathered using drone technology. The resultant ‘satellite-derived’ coastal habitat maps, a ‘first’ for both the Falkland Islands and South Georgia, will form an effective baseline measurement, providing a sound basis for planning, decision making and future monitoring.

A key part of the project, over and above the coastal habitat modelling/mapping, is the establishment of methods and systems for the Islands to allow these maps to be updated in the years to come. This latter part (the projects legacy) will be critical to ensure that future monitoring of the Falklands (**Figure 1.2**) and South Georgia (**Figure 1.3**) coastal habitats can continue after this project has ended.

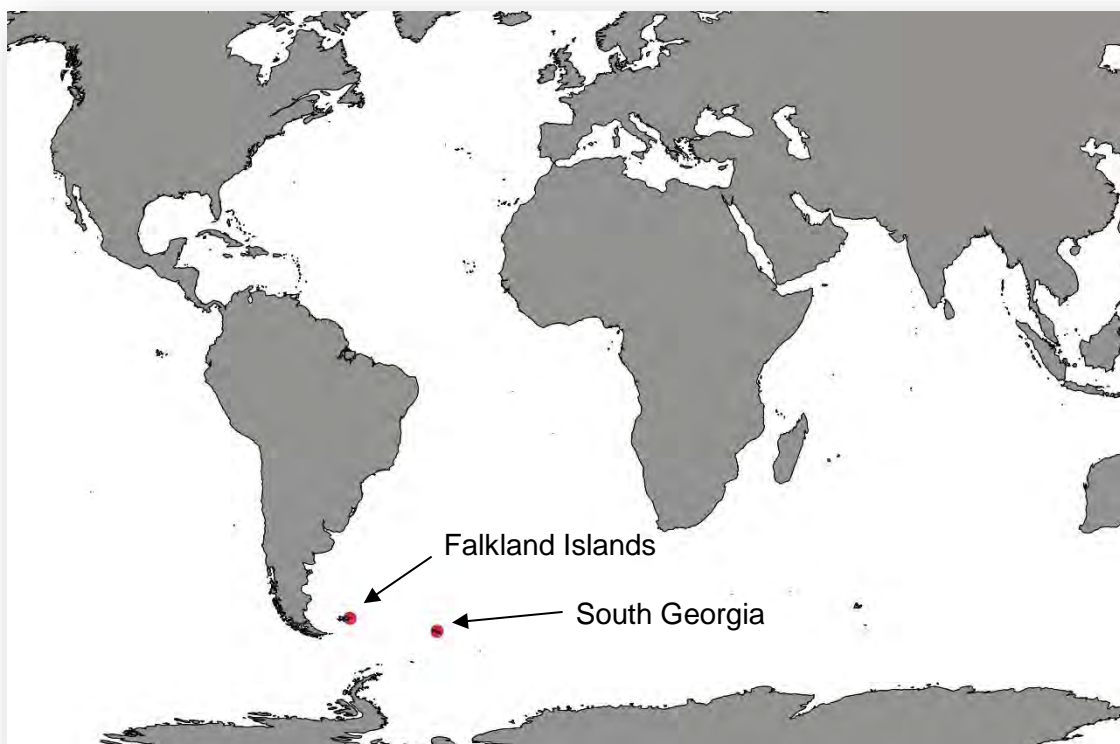


Figure 1.1: Location of the Falkland Islands and South Georgia in the South Atlantic. Map projection World Robinson

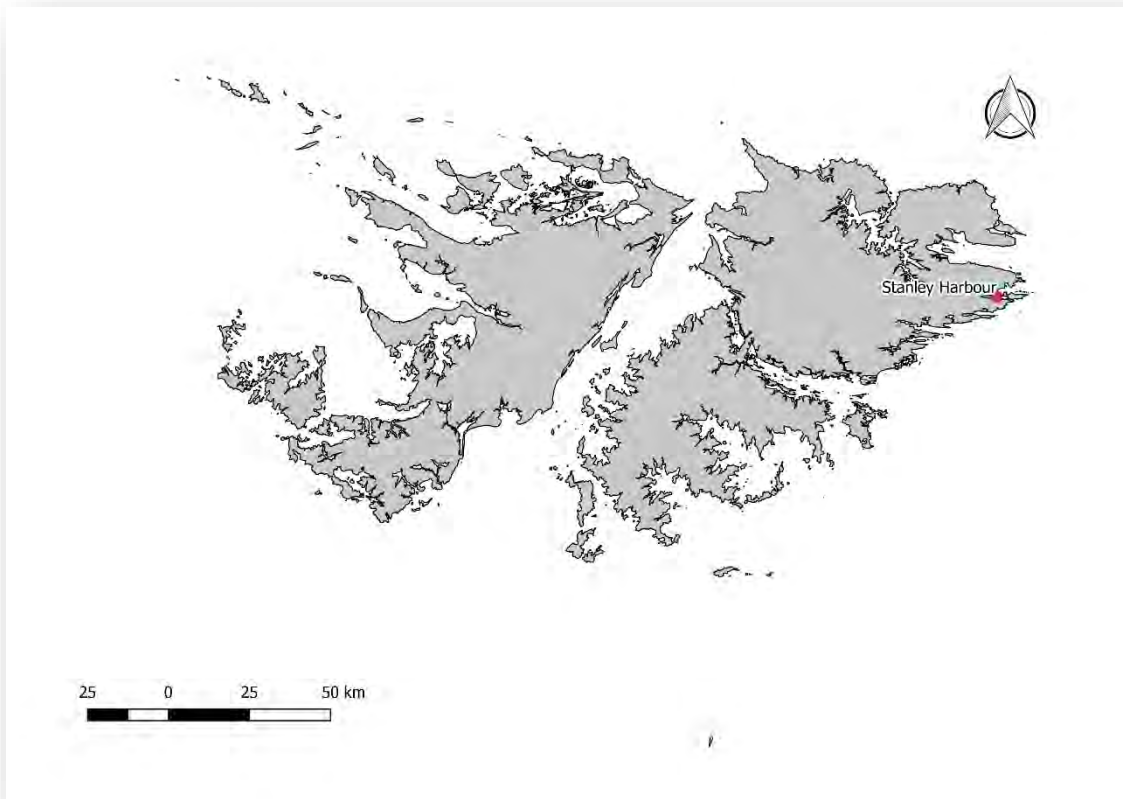


Figure 1.2: Falkland Islands, South Atlantic. The location of Stanley is indicated with a red dot. Map projection WGS84 UTM 21S

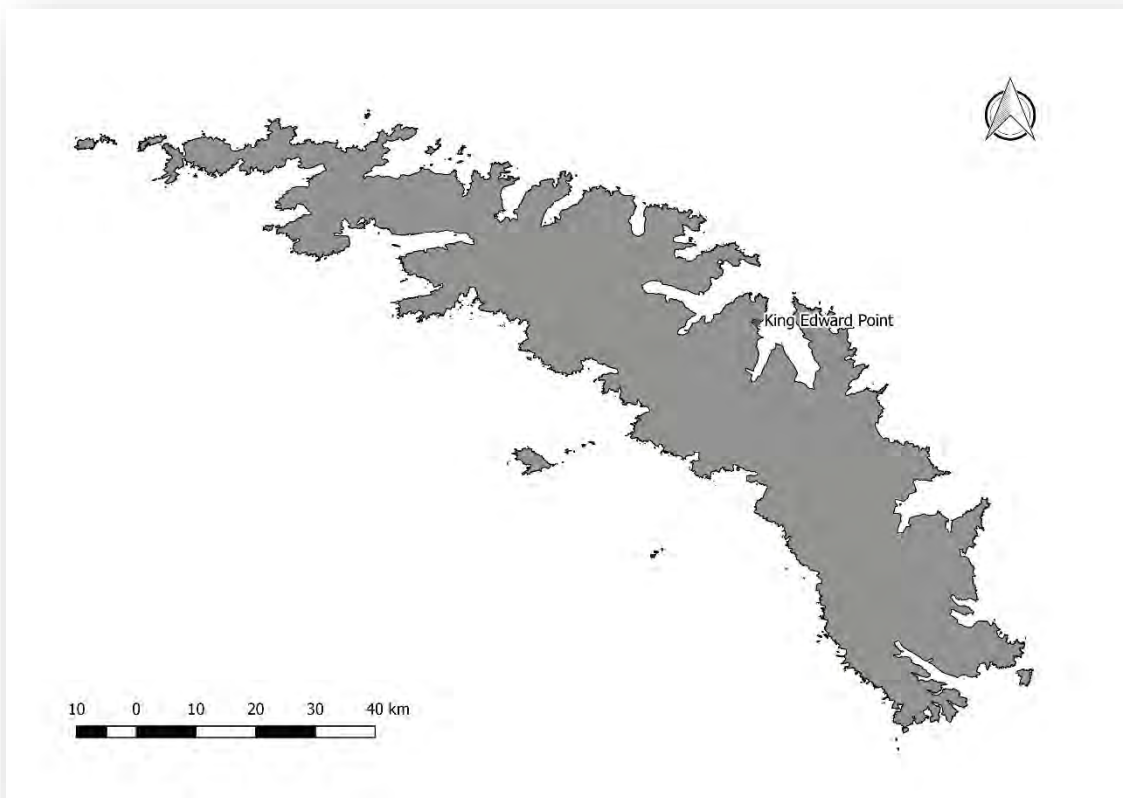


Figure 1.3: South Georgia, South Atlantic. The location of King Edward Point research station is indicated with a red dot. Map projection WGS84 South Georgia Lambert

3. Project stakeholders/partners

The project partners (**SAERI, Oregon State University (OSU), Falkland Islands Government (FIG), Government of South Georgia & the South Sandwich Islands (GSGSSI), Shallow Marine Surveys Group (SMSG) and Joint Nature Conservation Committee (JNCC)**) form the Project Management Group (PMG), and meet quarterly, to monitor and steer the project, ensuring it aligns with the project proposal document, and to ensure it delivers its outputs on time, and on budget. Documents relating to the PMG are available from the Coastal Mapping webpage.

Since the start of the project, **Falkland Islands Government (FIG)** and the **Government of South Georgia & the South Sandwich Islands (GSGSSI)**, both primary stakeholders who will utilise the project outputs as well as project partners, have been heavily involved in the project. GSGSSI in particular played a key role supporting the project during the Nov/Dec 2017 *FPV Pharos SG* expedition to South Georgia (**Annex 3**) (**Figure 2.1**). The expedition was a resounding success, delivered critical evidence for the project, and resulting in the first 'satellite derived' broad scale habitat maps being developed for South Georgia (**Indicator 3.2**). At the same time, excellent 'add-on' value was realised: one of the South Georgia field researchers assigned to the project is undertaking a PhD at the **Natural History Museum (NMH), London**, so an additional partnership has been forged through this project. The project has also highlighted a potential opportunity for one of the project partners (**Shallow Marine Surveys Group - SMSG**) to have their South Georgia invertebrate collection hosted at the NHM.



Figure 2.1: *The Coastal Mapping field team recording habitat information to 'train' computer models to classify satellite imagery on South Georgia.*

Throughout this first year of the project, consideration and involvement of the stakeholder community has been key, recognising that the project success is dependent upon stakeholder engagement. The first Project Stakeholder Group (PSG) meeting had been provisionally scheduled for March 2018, but due to availability of PSG members, was delayed until April 2018 (it has now occurred during the drafting of this report). However, in the intervening period, there has been significant, demonstrable engagement with a broad swathe of stakeholders, as outlined below.

After starting in post, the project manager (PM) held initial one to one meetings with each of the project partners (**FIG, GSGSSI, Oregon State University (OSU), Joint Nature Conservation Committee (JNCC) and SMSG**) as well as a range of stakeholders relevant to both territories. This enabled a good working relationship to evolve and an excellent rapport has been built, resulting in the smooth and steady progress across each of the projects work packages this year. Meetings of particular note included:

South Georgia Association (SGA)

The South Georgia Association are a key stakeholder for the South Georgia aspect of the project. The PM met with **Robert Burton** (& **Marcus Brittain** from Cambridge Archaeological Unit) to discuss the project (26th February 2018), SGA engagement through the PSG and a potential collaboration on an expedition to South Georgia in Feb/March 2019. Robert Burton now sits as the SGA representative on the Project Stakeholder Group. An article on the project was drafted in March for the SGA newsletter (**Annex 4**).

British Antarctic Survey (BAS)

BAS are a relevant stakeholder, particularly with respect to the South Georgia element. The PM met with **Adrian Fox, Head of Mapping and Geographic Information Centre** (24th January 2018) regarding the scope of the project in South Georgia. BAS have a long history of mapping and topographic/cartographic work in South Georgia, on behalf of GSGSSI; they have a wealth of expertise which could greatly benefit the project. Adrian Fox now sits on the Project Stakeholder Group (PSG). The PM also made contact with **Floyd Howard, Geophysical Data Manager at the Polar Data Centre** (26th January 2018) and arranged for a wealth of bathymetry data gathered from around South Georgia to be made available to the project.

Falklands Conservation (FC)

FC is a key project stakeholder, who provided a letter of support during the project proposal stage. The PM met with **Liz Milston**, leader of the **Falklands Conservation Community Watch Group** (21st February 2018) to discuss a Shackleton Scholarship Grant proposal being led on by the PM (bringing a drone expert down to the Falklands) as well as some potential outreach ideas. If successful, this Shackleton Scholarship would provide a wealth of outreach opportunities for this Darwin-Plus project. The PM also arranged a meeting with **Katherine (Frin) Ross** (planned for April 2018) who runs the Habitat Restoration project with FC to discuss the project aims, and how they relate to FCs Habitat Restoration project. Some clear synergies can be identified between projects, and would benefit from working closely together. Frin Ross now sits on the Project Stakeholder Group (PSG).

Wildlife Conservation Society (WCS)

WCS own some of the Jason Islands to the far west of the Falklands, and are the location of globally important populations of seabirds such as the Black-Browed Albatross. The PM liaised with Graham Harris (23rd March 2018), the WCS representative for the Falklands, regarding their involvement in the project and visiting some of the islands to map them as part of the field campaign.

UN Environment World Conservation Monitoring Centre (WCMC)

The PM met with **Edward Lewis** from WCMC (14th December 2017) who are undertaking work under contract to GSGSSI reviewing the terrestrial protected area network on South Georgia. The aim was to understand the work being undertaken by WCMC on behalf of GSGSSI, brief Ed on the new Darwin Plus project, and to see if the WCMC project timings would facilitate the use of the coastal mapping project outputs. The discussion concluded that the outputs of this coastal mapping project would be a useful baseline data layer for use during consideration of terrestrial protected areas. This discussion also highlighted the real impact that the coastal mapping project outputs will have upon completion.

Falkland Island landowners/farm managers

On the Falklands, the majority of land is privately owned, and often run by farm managers. The project identified these as a key stakeholder group where effective engagement is required to ensure success. The PM had informal discussions about the new project with the landowners/farm managers from **Elephant Beach Farm, Fitzroy Farm, Murrell Farm** and

Johnsons Farm, all located in East Falkland. By developing the methods and systems (through Google Earth Engine) to update the coastal habitat maps after the project has finished, along with training (through the dedicated training workshop), the project is providing a set of tools and legacy that this stakeholder group can effectively utilise to enhance their land management. Further engagement is planned for communities in West Falkland.

Further outreach to the wider stakeholder community across the Falkland Islands is planned at the start of Year 2, including planned articles in the Wool Press (<http://www.fig.gov.fk/agriculture/index.php/publications/wool-press>) and the Penguin News (www.penguin-news.com). At the time of writing this report, an interview for Falkland Islands Radio was planned (April 2018). It is also proposed to present the project to the Falkland Island Government Environment Committee.

(Evidence of the above meetings, in the form of correspondence, is available on request)

4. Project Progress

Whilst this Annual Report covers the period from April 2017 to March 2018, the project manager was not in post until 1st December 2017 (note that the project manager was initially scheduled to start in September 2017). Following delays in recruiting a project manager, discussed in more detail in 'Section 5: Lessons Learnt', the project was running up to 3 months behind schedule. However, this was approved through the change request process (approved by Defra on 9th March 2018). In summary, key changes were in the timings of deliverables across Work Packages and change in spend across financial years. A revised logical framework reflecting these changes was submitted and approved (**see Annex 2**)

To note: For clarification - progress against activities report here is aligned to the approved revised logical framework (Annex 2) as opposed to the original logical framework.

4.1 Progress in carrying out project Activities

Output 1: Project Management structure and communications tools established

Summary: The majority of planned activities for this year have been completed.

A project manager was recruited, and was in post by 1st December 2017 (**Activity 1.1**). The draft Memorandum of Understanding (MoU) was reviewed at the December 2017 Project Management Group (PMG) meeting. Following modification and further discussion at the March 2018 PMG meeting, the MoU was referred to the partners legal teams for final sign-off, anticipated in April 2018 (**Activity 1.2**). Terms of Reference for the PMG meetings have been drafted and approved by the PMG. The quarterly PMG have been held in October 2017, December 2017 and March 2018 (approved minutes are available from the project webpage) (**Activity 1.3**). Terms of Reference for the Project Stakeholder Group (PSG) meetings have been drafted and approved by the PMG. The first PSG was scheduled for March 2018, but due to availability of PSG members, was delayed until April 2018 (it has now occurred during the drafting of this report) (**Activity 1.4**). A dedicated Coastal Mapping project webpage has been developed on the SAERI website. The webpage provides background information about the project, the latest project news, as well as the 'go to place' for downloading documentation from project meetings, workshops etc. (**Activity 1.5**). Research Agreements have been drafted and signed by all project partners and contractors (OSU, JNCC, SMSG and Environment Systems), ensuring that the financial mechanisms are in place to disseminate project funds by the end of the financial year (**Activity 1.6**).

Output 2: Work Package 1: Digitised 50 year old aerial imagery (FI only)

Summary: All planned activities for this year have been completed.

The work undertaken for Work Package 1 this year primarily involves Oregon State University (OSU) and SAERI. In January 2018, the project manager visited the offices of OSU in Corvallis,

USA. During this visit, the PM discussed approaches with geospatial experts on the project team for how to tackle the geo-referencing of the 1956 aerial imagery for the Falkland Islands. It was agreed that while the aerial imagery covered the entire land mass of the Falklands, it was important to prioritise imagery from the coastal margin. A plan was agreed for tackling the geo-referencing of the 1956 aerial imagery (**Activity 2.1**). Work was then put on hold whilst effort was focussed on delivery of **Output 3** (Work Package 2: broad scale stage 1 coastal habitat maps of South Georgia). (*Evidence of the above meetings and discussions, in the form of correspondence, is available on request*).

Output 3: Work Package 2 - Object based image analysis and habitat modelling of the coastal margin (FI and SG)

Summary: All planned activities for this year have been completed.

The work undertaken for Work Package 2 this year primarily involves Oregon State University (OSU), Joint Nature Conservation Committee (JNCC) and SAERI. JNCC led on sourcing the Sentinel-1 and Sentinel-2 imagery for the project, and this was completed in the first half of the year (**Activity 3.1**). JNCC also led on the pre-processing of the satellite imagery, which was completed by end of Q3 (**Activity 3.2**). OSU led on the object based image analysis and habitat modelling to develop broad scale (Stage 1) coastal habitat maps under this Work Package. During the same visit to OSU offices in January 2018 outlined in Output 2 above, the project manager discussed approaches with OSU to best undertake the coastal habitat modelling and mapping. It was agreed to focus initially on delivering the terrestrial and intertidal elements, delivering the subtidal element of the maps later on in Year 2, due to their added complexity. Further detail on the habitat modelling methodology is provided in **Annex 5**.

Environmental Systems Ltd, under contract to SAERI, produced modelled aspect and fetch data layers for integration by OSU into the habitat modelling process. These data layers were created both for the Falkland Islands and South Georgia. (*Maps of these data layers are available on request*). Summary maps evidencing the completion of planned habitat mapping activities in Year 1 (**Activity 3.3 & 3.4**) are shown below (**Figure 3.1 & 3.2**). Once the subtidal South Georgia Stage 1 map has been completed, and the outputs merged with the terrestrial/intertidal layers, the Stage 1 map will be provided to GSGSSI to be made available online via the South Georgia GIS portal. (*Evidence of the above Sentinel-1 and Sentinel-2 data sourced and processed for the project can be found on the IMS-GIS Data Centre for the South Atlantic: <http://www.south-atlantic-research.org/metadata-catalogue>*)

South Georgia: Earth Engine Random Forest Classification
Six Vegetative Classes, Including Fertilized and Unfertilized Tussac

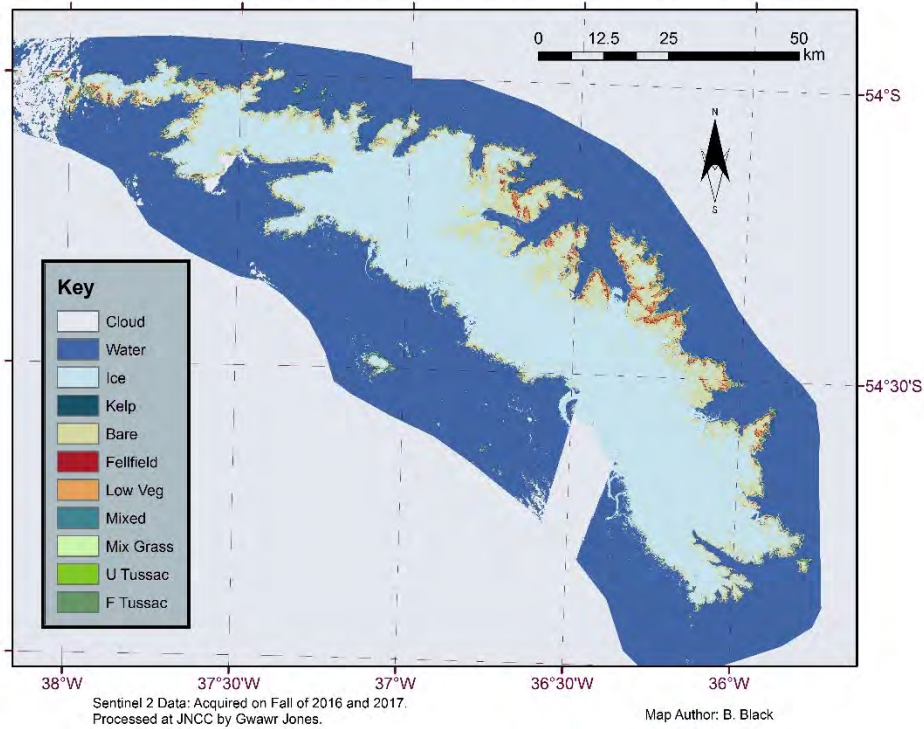


Figure 3.1: Broad scale (Stage1) coastal habitat map for South Georgia

South Georgia: Earth Engine Random Forest Classification
Six Vegetative Classes, Including Fertilized and Unfertilized Tussac

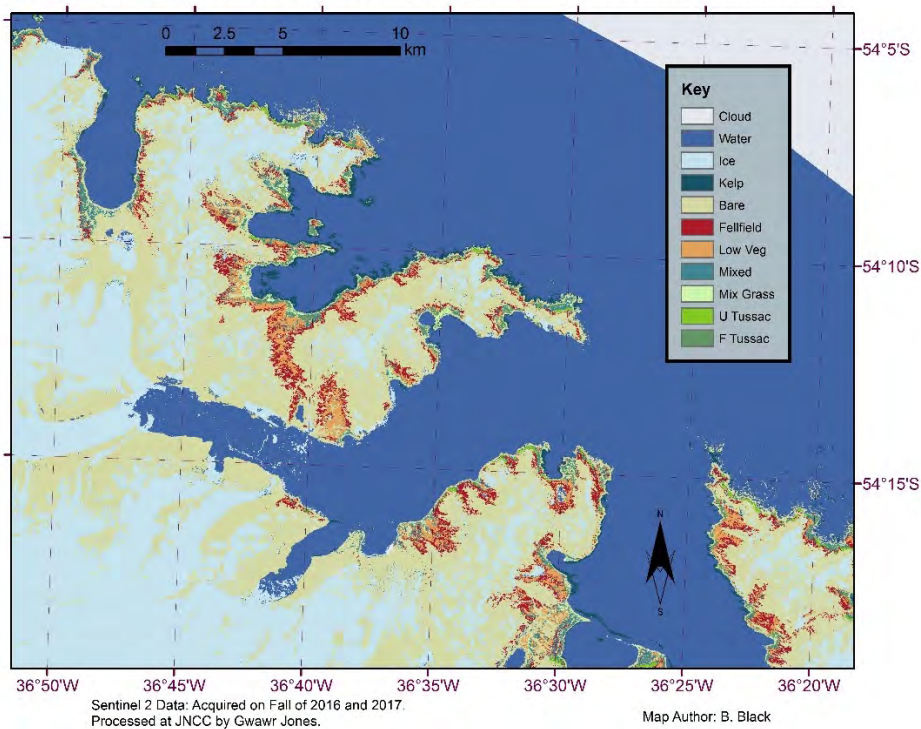


Figure 3.2: Broad scale (Stage1) coastal habitat map for South Georgia, showing a close up of Cumberland Bay West and East

Output 4: Work Package 3 - Identification, prioritisation and fulfilment of information data needs for the systematic conservation and planning of the coastal margin for the FI and for SG

Summary: All planned activities for this year have been completed and work planned for next year has commenced early.

The work undertaken for Work Package 3 this year primarily involves Oregon State University (OSU), Joint Nature Conservation Committee (JNCC) and SAERI. While the stakeholder workshop, the main route through which stakeholders will drive the identification and prioritisation of data needs with respect to the fine scale (Stage 2) coastal habitat mapping, is planned for later in Year 2, important groundwork has been undertaken regarding its planning. A provisional date (week commencing 6th August 2018) has been identified, and discussions have been held with project partners regarding the proposed format (**Activity 4.1 & 4.2**). A traditional one day workshop with 'stakeholders round the table' would work well for Falkland Islands stakeholders. However, in agreement with GSGSSI, the nature of South Georgia stakeholders with them being spread across many different countries suggests that an alternative approach needs exploring. Instead of a traditional 'round the table' workshop, the plan will be to circulate material (maps and a set of questions) round to South Georgia stakeholders with a view to holding a subsequent dedicated Skype conference at GSGSSI offices on an agreed date for all interested parties to feed back their views. GSGSSI and SAERI would then decide on a list of priorities for fine scale (Stage 2) mapping based on stakeholder needs.

It was originally envisaged that very high resolution satellite imagery (WorldView 2-4) would be purchased at the end of Year 1 to assist the Stage 2 fine scale mapping planned for Year 2. However, an opportunity presented itself, and SAERI worked with Oregon State University, who led the drafting of a proposal to the Digital Globe Foundation to provide complimentary imagery of the Falklands and South Georgia. OSU were successful in their bid, and the imagery is due for delivery in April 2018 (**Activity 4.5**). **This initiative has added significant value to this project, as the purchase of this imagery (c. £200,000) was out of scope for the original project. With the range of very high resolution imagery now available through the Digital Globe grant, it is envisaged that outputs will be even more robust.** (*Evidence in the form of the Digital Globe Foundation grant email can be made available on request*).

To support the acquisition of high resolution drone imagery (**Activity 4.5**), a drone has been purchased for use in Year 2 (*Evidence in the form of an invoice can be made available on request*).

SAERI in conjunction with GSGSSI led a successful expedition to South Georgia (Figure 3.3) in November/December 2017 to collect ground validation data in order to 'train' the computer model used to develop the coastal habitat map for South Georgia (**Activity 4.8**). As planned, the expedition 'piggy-backed' on an existing South Georgia rat eradication project field trip, which allowed for good coverage of the South Georgia Coastline. Preparation ahead of the expedition was supported by OSU and JNCC, involving the review of satellite imagery to identify and prioritise areas where ground validation information would be required. A sampling protocol methodology (complete with recording forms) was also developed (Annex 6). Training of the field team in using the methodologies was carried out by SAERI on the Falkland Islands ahead of the expedition. Despite experiencing challenging weather conditions (which did result in some downtime) a significant amount of ground validation information was achieved. Figure 3.4 shows the extent of ground validation records collected on the expedition. This data was then processed, quality checked, and integrated into the habitat modelling process – both as 'training' and 'validation' data (a further explanation is provided in **Annex 5**).



Figure 3.3: (Top) Look across Cape North, South Georgia. (Bottom) Gold Harbour, South Georgia, with the FPV Pharos SG waiting in the bay for the safe return of the field team.

With respect to subtidal sampling to support the creation of the subtidal element of the coastal habitat maps, existing 2010 South Georgia dive expedition data (from our SMSG partners) has been entered into Marine Recorder (a Microsoft Access database application) as part of this project so it is readily integrated into the modelling process. In addition, discussions have been held with SMSG and OSU regarding planning for subtidal survey expeditions in Year 2 and Year 3 of the project (**Activity 4.8**).

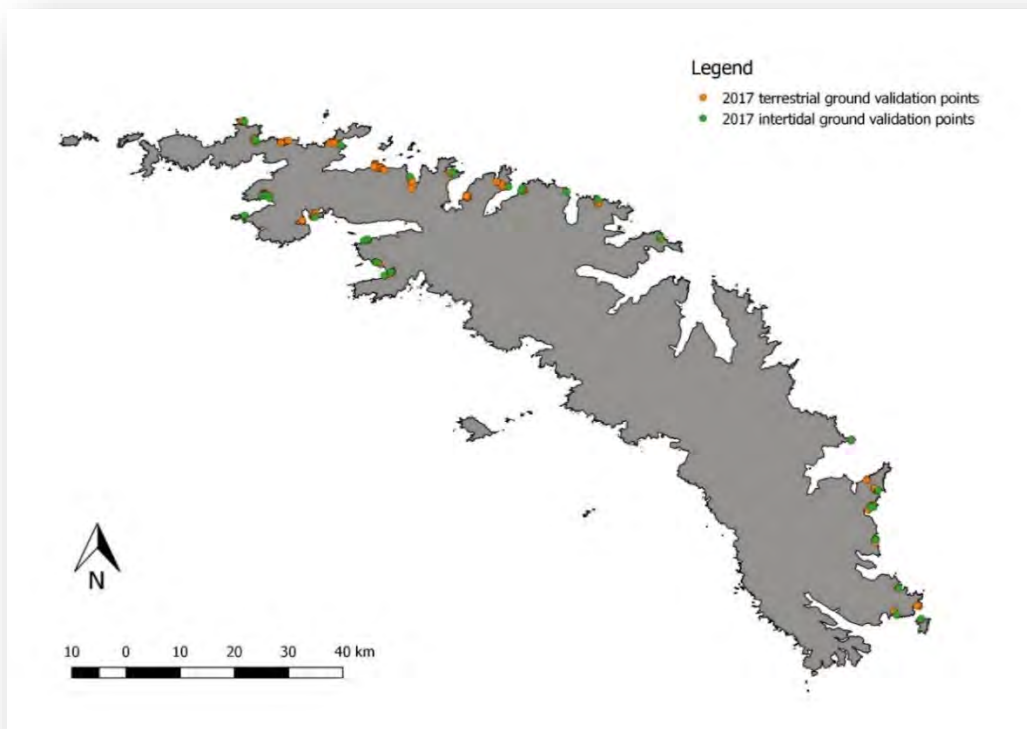


Figure 3.4: The extent of ground validation records collected during the 2017 South Georgia field expedition. Orange points represent terrestrial records whilst green points represent intertidal records.

Output 5: Work Package 4 - Prioritisation of ongoing planning, protection and monitoring of the coastal margin

Summary: No activity was planned under this Work Package this year.

Output 6: Work Package 5 - All outputs integrated with existing and emerging initiatives

Summary: All planned activities for this year are underway.

Work has commenced in Q4 to review existing (relevant) stakeholder groups and data creation/data management initiatives and protocols (**Activity 6.1**). This work will conclude in Q1 of Year 2.

A separate strand of work under this Work Package is the piloting of a cloud-based system through which the coastal habitat models will run. For this purpose, Google Earth Engine is being piloted. This is an important consideration for small island territories such as the Falklands and South Georgia, where internet connectivity (bandwidth) is limited and downloading the large files associated with Earth Observation and satellite imagery is prohibitive. Early results in Q4 of Year 1 are very encouraging and this Google Earth Engine system/interface will be further developed in Year 2. The use of Google Earth Engine, alongside the planned training workshop in Year 3, will help deliver the ultimate goal of leaving a legacy of skills and systems in both Territories in order to use satellite imagery in habitat classifications and for long term monitoring.

Output 7: Monitoring and Evaluation

Summary: All planned activities for this year are complete.

A monitoring and evaluation plan was prepared in Q4 of Year 1 (**Activity 7.1**) and is available for download from the Coastal Mapping project webpage. See Section 4. for more detail.

4.2 Progress towards project Outputs

There has been steady overall progress towards achieving the project outputs, and despite the delay in getting a project manager in post, **appropriate re-planning and rigorous project controls have ensured that the project is now on track.**

Output 1 involves establishing the project management structure and communication tools, not present at the project conception. Overall progress of this Output is good. The baseline here was that none of the project management structures were in place before the start of the project. All work (and associated **Indicators 1.1, 1.3, 1.4 & 1.5**) is complete for this year with the exception of a final, signed MoU (**Indicator 1.2**); a final draft has been approved by the Project Management Group (PMG) pending final sign-off from partner's legal teams. However this is considered a formality and no issues are anticipated by the PMG, as more detailed bi-lateral research agreements outlining payments and deliverables have been signed off. The indicators in use for Output 1 remain appropriate, and are measured according to the M & E plan. All (non-confidential) indicator means of verification (**1.3, 1.4, 1.5**) are available online.

Output 2 deals with the geo-referencing of 1956 aerial imagery for the Falklands – the baseline is that this imagery is currently not geo-referenced. Overall progress is satisfactory and a workflow has been devised to take this work forward in Year 2 (noting the assumptions noted in 3.4). **Indicator 2.1** has been achieved this year. The indicators in use for Output 2 remain appropriate, and are measured according to the M & E plan.

Output 3 considers the development of broad scale (Stage 1) coastal habitat maps for the Falklands and South Georgia. The baseline was that there was no detailed, systematic (satellite derived) coastal habitat mapping before. Excellent progress has been made, delivering a 'first' for South Georgia; the first satellite derived coastal habitat map for the island. **Indicator 3.2** has been achieved this year, and is available on request – see also figures 3.1 and 3.2 for examples.

The indicators in use for Output 3 remain appropriate, and are measured according to the M & E plan.

Output 4 deals with the identification, prioritisation and fulfilment of information data needs for the systematic conservation and planning of the coastal margin for the FI and for SG. Good progress has been made, particularly with the fieldwork elements. **Indicator 4.2** has been partly achieved this year - as far as could be expected. The indicators in use for Output 4 remain appropriate, and are measured according to the M & E plan.

Output 5 involves the prioritisation of ongoing planning, protection and monitoring of the coastal margin. No work was planned under this Output in Year 1. The indicators proposed for Output 5 remain appropriate, and will be measured according to the M & E plan.

Output 6 deals with the integration of project outputs with existing and emerging initiatives. The initiatives review commenced in Q4 of Year 1 and will extend into Year 2. Piloting of the cloud-based system (Google Earth Engine) has also commenced. Steady progress delivering this Output has been made in Q4 of this year. **Indicator 6.1** has been partly achieved this year - as far as could be expected. The indicators in use for Output 6 remain appropriate, and are measured according to the M & E plan.

Output 7 considers the monitoring and evaluation of the project. Progress for this Output was good, with **Indicator 7.1** being achieved. The indicators in use for Output 7 remain appropriate, and are measured according to the M & E plan.

4.3 Progress towards the project Outcome

This year, the project has made good progress to achieve the project Outcome “mapping generated from this cost-effective and innovative remote-sensing will underpin and enhance spatial and conservation planning in the remote Falkland Islands and South Georgia and allow for efficient, effective monitoring”. Considering the baseline with neither Territory having an island-wide coastal habitat map, excellent progress has been made, with a broad scale ‘satellite-derived’ habitat map being completed for South Georgia. The production of this map for South Georgia (**Figure 3.1 & 3.2**) provides a ‘proof of concept’ that the combination of satellite imagery, additional data layers (including ground validation), data systems and methodologies work, and can be efficiently and effectively rolled out to the larger area of the Falkland Islands. The indicator (**Indicator 0.1**) is deemed appropriate, and with a comprehensive team of Stakeholders and project partners on board, we can ensure that the final project outputs are at the required spatial and temporal scales for use by Partners and Stakeholders alike, and the project is already generating ideas and thinking around how the maps and other outputs can feed into spatial and conservation planning. It is envisaged that the project will achieve its Outcome by the end of March 2020.

4.4 Monitoring of assumptions

It is important that the stated risks and assumptions identified at the start of the project (**Annex 2**) are still relevant. For example, in **Output 1**, the risks and assumptions identified around the ability to recruit a project manager with the relevant skills were borne out, with a delay in successfully recruiting a project manager necessitating the re-planning/re-profiling of deliverables and budgets in the last quarter.

When considering the risks/assumptions for **Output 2**, while the original assumption still holds true, in that a review of the 1956 aerial imagery does suggest it is of a suitable quality for digitising – this in fact may present its own issues, with large files size and sufficient computing power necessary to mosaic and geo-reference the images. A further consideration needs to be given to whether the workflow developed this year can be automated. With approx. 3688 aerial images across the Falklands, and assuming it takes 5 minutes to manual geo-reference each image, it would take over 43 days to geo-reference all images. This is before consideration is given to the

time required for undertaking quality checks. These potential issues will be further explored when work recommences on this Work Package.

Regarding **Output 3**, the maps produced for South Georgia adequately demonstrate that this Output is achievable, and that the methodology proposed is feasible.

The assumptions for **Output 5 & 6** but the assumptions appear realistic.

These assumptions have been incorporated into a project risk register and are being monitored as part of the monitoring and evaluation process.

4.5 Project support to environmental and/or climate outcomes in the UKOTs

Both Territories have plans and policies in place that address the lack of coastal knowledge.

In the Falklands, the Islands Plan (2018 – 2022) contains a number of targets where the Outputs of this project could significantly advance knowledge and provide baseline conditions from which to detect future change and trends. They include:

- The implementation of the 2030 Biodiversity Framework to preserve our natural environment;
- Implement control of invasive species, biosecurity and eradication plans;
- Encourage natural habitat restoration and preservation;

For South Georgia, the 2016-2020 Biodiversity Action Plan published by GSGSSI, a key project partner for that Territory, includes a target to “*Enhance knowledge of the biodiversity and habitats of GSGSSI [...], including the establishment of scientific baselines from which to monitor environmental change.*”

For South Georgia, there are clear links between this BAP target and the mapped scientific baselines this project will deliver. In our discussions with our project partners in GSGSSI, there is already interest in exploring how the maps that have been generated can feed into other projects.

In terms of the development of capacity for environmental management, this will be more explicit in the next year of the project, as there are various capacity building activities scheduled however it might be useful to note here (as mentioned in section 3.1 under output 6) the project is trying to develop innovative ways to use satellite imagery for long term monitoring with minimal technical expert requirements for the follow-up monitoring stages, enabling resource-limited small islands to be able to efficiently and effectively do this themselves. These tools will be developed in year 2 of the project, so there isn't any evidence available yet.

5. Monitoring and evaluation

A **Monitoring and Evaluation plan** has been developed for this project and is available on request. Some of the fundamental of the plan, as alluded to in the application form, are outline here. In addition, some aspects of this M&E are also stated in Section 3 above.

The project is effectively governed through an established **Project Management Group** (PMG) (**Activity 1.3**); all project partners (SAERI, GSGSSI, FIG, OSU, JNCC and SMSG) sit on the PMG. There is also a separate **Memorandum of Understanding** (MoU) (**Activity 1.2**), signed by all partners, which underpins the partnership. The project manager has responsibilities to present a quarterly report on progress against deliverables, M&E and quarterly financial reports to the PMG. The project manager also has responsibilities to maintain an **Issues Log** and project **Risk Register** which are also presented to the PMG at quarterly intervals.

The PMG is tasked with ensuring that the project delivers its outputs on time and on budget. The PMG also has a responsibility to review and monitor the quality of the outputs

Trello, an online (cloud-based) project management tool has been utilised to ensure all members of the PMG have secure access to relevant documents, irrespective of their location.

Through the establishment of a wider **Project Stakeholder Group (PSG) (Activity 1.4)**, there is an ability to check the relevance of planned products with a suite of potential end users. This is formalised through the planned biannual stakeholder meetings. This project has a specific requirement to illicit direction from the stakeholder network to determine priorities for fine scale habitat mapping across both Territories, through a dedicated workshop (**Activity 4.3**).

6. Lessons learnt

At the end of Year 1, but with a project manager in post for only four months, the project is still at an early stage to comment extensively on lessons learned. However, what is worth noting is the high project partner enthusiasm which may be attributed to the pre-project submission dialogue and buy-in with partners, which has been carried through to the project now underway. This partner enthusiasm and buy-in means that the outputs being developed are more likely to be used for conservation planning. The partners have also worked together to bring added value to the project, such as the successful Digital Globe Foundation submission for satellite imagery.

A key lesson that has been learnt is around the planning for project delivery before the recruitment of a project manager. In this particular project, the timeline had been developed to take into account longer recruitment times which meant that the Project Manager was only scheduled to be in post 6 months after the project start date. However, the first round of recruitment was unsuccessful and therefore had to be revisited, which took longer than expected. In addition some project activities had been planned between partners before the PM recruitment, and these could have been reduced, as the PM is required to effectively move these processes forward.

7. Actions taken in response to previous reviews (if applicable)

Not applicable as this is the first Annual Report submitted for the project.

8. Other comments on progress not covered elsewhere

The project has highlighted the potential of using drones in UKOTs, and has generated enthusiasm in this regard (for example, meetings held with the FIG Agriculture Department for using drones for mapping invasive plant species such as *Calafate* – *Evidence: meeting notes available on request*). This project also effectively 'spawned' a Shackleton Scholarship Fund application by the project manager (*Evidence: Shackleton Scholarship Fund proposal submitted at end of March 2018 and available on request*) to get a drone expert down to the Falklands to work with the community to promote how their safe use can really benefit science, education and more.

A particular risk which has been captured within the project risk register, is one around how the project in question sits with existing work and its relative priority. While the same may not be said for all Territories, there is a relatively small pool of people both within the Falklands and South Georgia who are working in the field of environmental policy, research and conservation. Therefore, staff are often very busy, and it is challenging to ensure the project receives sufficient attention from relevant partners/stakeholders/wider users. By maintaining regular contact with key stakeholders (especially one to one meetings), providing strong advocacy for the project and emphasising the benefits of the project outputs to other work/projects/policy drivers, it is possible

to mitigate for this. However, it is certainly worth considering how the project may sit with other ongoing work at an early project planning phase.

Finally, the value of having a project manager based locally on the islands cannot be underestimated. They have the ability to react to, and take advantage of, opportunities that occur locally, rather than interacting remotely.

9. Sustainability and legacy

The profile of the project has increased significantly over the last quarter since a dedicated project manager has been in post. The regular project management group meetings, and the project stakeholder group meetings serve as important platforms for engagement, promotion and awareness of the work with key stakeholders in the islands. Regular postings of project activity to Twitter (the project has a dedicated hashtag #SouthAtlanticCoastalMapping) and Facebook have helped raise the profile more widely (see section 9 for more detail on social media). The dedicate blog published by the field researchers on the expedition to South Georgia generated significant interest (**Annex 3**). Meanwhile, articles published in newsletters such as those published by the South Georgia Association (**Annex 4**) expose the project to an alternative audience.

Further exposure through local newspaper articles and evening presentations are planned for early in Year 2. A radio interview promoting the project is also scheduled for April 2018.

An *aide memoire* when promoting the project on social media has been created and circulated to project partners (**Annex 7**).

The project has established a locally-led partnership, represented through the Project Management Group (which includes government representatives from both Territories) and wider Project Stakeholder Group.

Importantly, the project is building the habitat models, systems and methodologies within Google Earth Engine to enable regular updating of coastal habitat maps, even after the project itself draws to a close. This is further reinforced by the planned training workshop in Year 3 which will ensure the necessary skills are presented to interested island-based individuals. These will be a key legacy of the project.

Data generated through the project will be made available for future initiatives, through the IMS-GIS Database.

In addition, the project manager is based on the Falkland Islands, working for SAERI – a Falklands-based institution, therefore there is a strong local connectivity for the full duration of the project.

10. Darwin identity

Over the past four months since the project manager has been in post, several activities have been undertaken to promote the project, and the Darwin Initiative funding for the project. The project has followed Clause 21 of the Darwin Terms and Conditions¹, and has used the Darwin logo where possible.

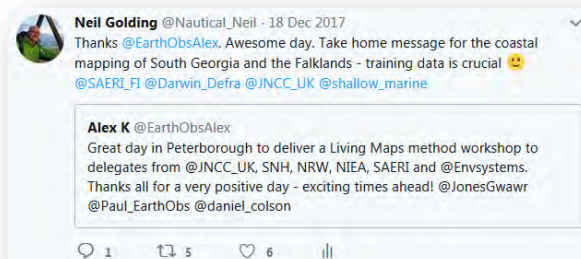
The project used the Darwin logo and/or the following acknowledgement “grant aided by the Darwin Initiative through UK Government funding” through the following outreach:

- South Georgia coastal mapping expedition blog (**Annex 3**)

¹ Schedule of Terms and conditions for Darwin Plus awards 2017-2018.

- South Georgia Association newsletter (**Annex 4**)
- Various Tweets and Facebook posts about the coastal mapping project where @Darwin_Defra (Twitter) and @DarwinInitiative (Facebook) have been tagged.

A sample of tweets can be seen below. Note that SAERI has 1174 followers.



11. Project Expenditure

Due to unavoidable delays in the recruitment of the project manager, the timing of the delivery of specific work packages and a revision to the budget allocation across years was required. The latter was managed primarily through a change in the payment terms with project partners, whilst delivery remained the same. A change request was submitted on 19th February 2018 and approval was received on 9th March 2018. The project grant figures used below reflect those in the approved change request.

Table 1: Project expenditure during the reporting period (1 April 2017 – 31 March 2018)

Project spend (indicative) in this financial year	2017/18 D+ Grant (£)	2017/18 Total actual D+ Costs (£)	Variance %	Comments (please explain significant variances)
Staff costs	47,120.00	47,120.00	0.00	n/a
Consultancy costs	1,500.00	1,500.00	0.00	n/a
Overhead Costs	7,476.74	7,476.74	0.00	n/a
Travel and subsistence	9,668.47	9,654.71	-0.14	n/a
Operating Costs	1,047.50	1,047.50	0.00	n/a
Capital items	37.11	37.11	0.00	n/a
Others (Please specify)	22,248.88	22,248.88	0.00	n/a
TOTAL	89,098.90	89,061.79		

Annex 1: Report of progress and achievements against Logical Framework for Financial Year 2017-2018 – if appropriate

Project summary	Measurable Indicators	Progress and Achievements April 2017 - March 2018	Actions required/planned for next period
<p>Impact</p> <p>Environmental evidence-base for decision-making on the FI and SG is significantly enhanced by the provision of baseline data in a thematic area that is a current gap i.e. coastal margin.</p>		<p>The production of a broad scale (Stage 1) coastal habitat map for South Georgia is the first of its kind ('satellite-derived' map), and has effectively plugged this data/knowledge gap for South Georgia. This is of key importance to GSGSSI, and sets the scene for the more detailed (fine scale) mapping in South Georgia, the locations of which will be prioritised in Year 2.</p>	
<p>Outcome</p> <p>The mapping generated from this cost-effective and innovative remote-sensing will underpin and enhance spatial and conservation planning in the remote FI and SG and allow for efficient, effective monitoring.</p>	<p>0.1 Coastal margin habitats are broadly classified and are visualized via digital outputs (e.g. maps, GIS layers) at spatial and temporal scale sufficient for spatial planning and decision making for FI and SG.</p>	<p>This year, the project has made good progress to achieve the project Outcome. The production of this map for South Georgia (Figure 3.1 & 3.2) provides a 'proof of concept' that the combination of satellite imagery, additional data layers (including ground validation), data systems and methodologies work, and can be efficiently and effectively rolled out to the larger area of the Falkland Islands</p>	<ul style="list-style-type: none"> • Completion of Stage 1 subtidal map for South Georgia and Stage 1 coastal habitat map for the Falkland Islands • Stakeholder workshop to prioritise areas for fine scale (stage 2) mapping • Fieldwork to collect ground validation information in Falkland Islands and South Georgia.
<p>Output 1.</p> <p>Project Management structure, and communications tools established</p>	<p>1.1 Project Manager recruited by end Quarter 3 FY 17/18.</p> <p>1.2 An MoU agreed and signed by all partners by end Quarter 4 FY 17/18.</p> <p>1.3 A Project Management Group (PMG) meeting held every 3 months starting October 2017.</p> <p>1.4 A Project Stakeholders group (PSG) meeting held every 6 months starting Quarter 4 FY 17/18.</p>	<p>1.1 <i>PM recruited for two years (until 30th November 2019). Note that the PM post ends four months prior to the end of the project in March 2020. Indicator is appropriate. Evidence of contract available on request from SAERI.</i></p> <p>1.2 <i>On track - MoU drafted and approved by PMG, pending final sign-off by partner legal teams (this is anticipated in April 2018). Evidence – MoU draft available on request – final MoU will be available for download from the project website. Indicator is appropriate.</i></p> <p>1.3 <i>On track – Terms of Reference approved by PMG, meetings held & approved minutes available on the project website. Indicator is appropriate.</i></p>	

	<p>1.5 At least 1 project webpage created by end Quarter 4 FY 17/18, and at least 1 update to the page made every month.</p> <p>1.6 Final project report produced by March 2020.</p>	<p>1.4 <i>On track – Terms of Reference approved by PMG & first meeting held (note in April 2018). Approved minutes will be available on the project website. Indicator is appropriate.</i></p> <p>1.5 <i>On track – Project website developed. Indicator is appropriate</i></p> <p>1.6 <i>N/A in this reporting period. Will be carried out in Year 3 - Indicator is appropriate</i></p>
Activity 1.1: Advertise, interview and recruit PM		<i>Completed</i>
Activity 1.2: Draft and sign Project Partners MoU		<i>MoU drafted and approved by PMG, pending final sign-off by partner legal teams (this is anticipated in April 2018).</i>
Activity 1.3: Quarterly PMG meetings		<i>Completed</i>
Activity 1.4: 6 monthly PSG meetings		<i>Completed – although note that meeting was actually held in April 2018, due to rescheduling requirements.</i>
Activity 1.5: Monthly Webpage updates		<i>Completed</i>
Activity 1.6: Complete various project management activities		<i>Completed</i>
Activity 1.7: Final project report and publicity		<i>Planned for completion in Year 3</i>
<p>Output 2.</p> <p>Work Package 1 (WP1): Digitised 50 year old aerial imagery (FI only)</p>	<p>2.1 Commence geo-referencing of 1954 aerial imagery by Quarter 4 FY 17/18.</p> <p>2.2 Complete geo-referencing of 1954 aerial imagery to create a digital map by end Quarter 2 FY 18/19</p>	<p>2.1 <i>Overall progress is satisfactory and a workflow has been devised to take this work forward in Year 2 (noting the assumptions noted in 3.4). Indicator is appropriate.</i></p> <p>2.2 <i>Planned for completion next reporting period – Indicator is appropriate</i></p>
Activity 2.1: Explore development of a workflow to aid the geo-referencing 1954 aerial imagery		<i>Completed</i>
Activity 2.2: Complete the geo-referencing of 1954 aerial imagery along the coastal margin		<i>Planned for completion next reporting period</i>

Activity 2.3: Produce a digital map of the 1954 aerial imagery showing the coastal margin		<i>Planned for completion next reporting period</i>
Activity 2.4: Upload the 1950's coastal margin (aerial imagery) map onto the MSP GIS portal and a copy of the associated metadata onto the South Atlantic metadata catalogue		<i>Planned for completion next reporting period</i>
Output 3. Work package 2 (WP2): Object based image analysis and habitat modelling of the coastal margin (FI and SG)	<p>3.1 Stage I habitat modelling and classification complete for the Falklands by September 2018.</p> <p>3.2 Stage I habitat modelling and classification (terrestrial and intertidal) complete for South Georgia by end March 2018.</p> <p>3.3 Stage I habitat modelling and classification (subtidal) complete for South Georgia, and integration with terrestrial and intertidal habitat maps (3.2) by end July 2018</p>	<p><i>3.1 Planned for completion next reporting period – Indicator is appropriate</i></p> <p><i>3.2 Excellent progress has been made, delivering a 'first' for South Georgia; the first satellite derived coastal habitat map for the island – Indicator is appropriate</i></p> <p><i>3.3 Planned for completion next reporting period – Indicator is appropriate</i></p>
Activity 3.1: Source the Satellite imagery for the Falklands and South Georgia		<i>Completed</i>
Activity 3.2: Pre-processing of satellite imagery to prepare for analysis		<i>Completed</i>
Activity 3.3: Undertake Analysis of the satellite imagery and habitat modelling		<i>Partially Completed – Broad scale maps for South Georgia (Stage I maps) completed – habitat model is performing well – The modelling work has highlighted a requirement for additional ground validation samples on South Georgia – bad weather on field trip meant that not all sites could be completed.</i>
Activity 3.4: Produce a Coastal Margin habitat map for South Georgia and the Falklands		<i>Partially Completed - South Georgia coastal map (stage 1) complete</i>
Activity 3.5: Upload the Coastal Margin habitat map onto the MSP GIS portal (for the Falklands) and supply SG map to GSGSSI (for upload to GSGSSI web portal); upload a copy of the associated metadata onto the South Atlantic metadata catalogue.		<i>Being undertaken in Year 3</i>
Output 4. Work Package 3 (WP3): Identification, prioritisation and fulfilment of information data needs for the systematic conservation and	4.1 At least 1 FI (Q3 FY 18/19) and 1 SG (Q3 FY 18/19) stakeholder workshop held to identify and prioritise data needs for the coastal margin	<i>4.1 Planning for stakeholder workshop (Activity 4.1 – 4.4) commenced – proposed date week commencing 6th August 2018. Indicator is appropriate</i>

<p>planning of the coastal margin for the FI and for SG.</p>	<p>4.2 Ground truthing of satellite imagery analysis on SG (Quarter 3 FY 17/18 & Quarter 4 FY 18/19) and the FI (Quarter 1 – Quarter 4 FY 18/19)</p> <p>4.3 Stage II geospatial data products reflecting prioritized information needs utilizing high res imagery to reduce uncertainty in habitat models/classifications and address spatial and temporal data priority needs expressed by stakeholders – for both the FI and SG by Quarter 1 FY 19/20</p>	<p><i>4.2 Good progress has been made, particularly with the fieldwork elements. Very high resolution satellite imagery acquired through Digital Globe Foundation proposal. Purchased first drone for acquisition of high resolution imagery in Activity 4.5. Plans are underway regarding an additional fieldwork opportunity in South Georgia – Feb/March 2019 – budget reallocated (through approved change request) as a contribution to expedition/vessel charter costs. Early discussions with GSGSSI regarding additional research permit. Early discussions and planning meeting with expedition organisers completed. Indicator is appropriate</i></p> <p><i>4.3 For completion in Year 3 - Indicator is appropriate</i></p>
<p>Activity 4.1: Confirm Stakeholder workshop (to identify and prioritise spatial and temporal data priority needs expressed by Stakeholders) date, venue, and participants for the Falklands and South Georgia</p>	<p><i>For completion in next reporting period</i></p>	
<p>Activity 4.2: Confirm Stakeholder workshop programme, speakers and facilitators through consultations via the PMG and PSG for the Falklands and South Georgia</p>	<p><i>For completion in next reporting period</i></p>	
<p>Activity 4.3: Host the Stakeholder workshop for the Falklands and South Georgia</p>	<p><i>For completion in next reporting period</i></p>	
<p>Activity 4.4: Produce the Stakeholder workshop report for the Falklands and South Georgia and upload onto the project webpage</p>	<p><i>For completion in next reporting period</i></p>	
<p>Activity 4.5: Acquire very high resolution satellite imagery (e.g. WorldView) and/or undertake drone missions to acquire high resolution imagery for priority areas requiring fine-scale mapping in South Georgia and the Falklands</p>	<p><i>Successfully applied through the Digital Globe Foundation for 'free' very high resolution satellite imagery to support the project. Imagery valued at over £210,000, this is a fantastic gain for the project, and for Darwin. Drone purchased. Bulk of work to be undertaken in next reporting period.</i></p>	
<p>Activity 4.6: Pre-process the imagery to prepare for analysis</p>	<p><i>For completion in next reporting period</i></p>	
<p>Activity 4.7: Undertake analysis of the imagery.</p>	<p><i>For completion in next reporting period</i></p>	
<p>Activity 4.8: Undertake ground-validation of analysed data on the Falklands and South Georgia</p>	<p><i>Field expedition to South Georgia complete. Fieldwork to commence in Falklands in Year 2. Opportunity to collaborate on further field expedition to South Georgia being investigated with South Georgia Heritage Trust/ South Georgia Association.</i></p>	

Activity 4.9: Produce detailed (Stage II) Coastal Margin habitat maps for priority areas for South Georgia and for the Falklands		<i>For completion in next reporting period</i>
Activity 4.10: Upload the detailed (Stage II) Coastal Margin habitat map onto the MSP GIS portal (for the Falklands) and supply to GSGSSI for upload onto the GSGSSI web portal. Upload a copy of the associated metadata onto the South Atlantic metadata catalogue.		<i>For completion in next reporting period</i>
Output 5. Work Package 4 (WP4): Prioritisation of ongoing planning, protection and monitoring of the coastal margin	<p>5.1 A monitoring manual produced for long-term monitoring of coastal margin for the Falklands by end Quarter 3 FY 19/20</p> <p>5.2 A monitoring manual produced for long-term monitoring of coastal margin for South Georgia by end Quarter 3 FY 19/20</p> <p>5.3 At least 1 face-to-face training workshop in implementing monitoring undertaken by end Quarter 2 FY 19/20</p>	<p><i>5.1 For completion in Year 3 - Indicator is appropriate</i></p> <p><i>5.2 For completion in Year 3 - Indicator is appropriate</i></p> <p><i>5.3 For completion in Year 3 - Indicator is appropriate</i></p>
Activity 5.1: Draft a long-term coastal mapping/monitoring manual for the Falklands and South Georgia and upload onto the project webpage		<i>For completion in final reporting period</i>
Activity 5.2: Confirm date, venue, and participants for the Falklands and South Georgia coastal mapping/monitoring training workshop		<i>For completion in next reporting period</i>
Activity 5.3: Undertake coastal mapping/monitoring training workshop		<i>For completion in final reporting period</i>
Activity 5.4: Record videos of training sessions and upload online onto the project webpage		<i>For completion in final reporting period</i>
Output 6. Work Package 5 (WP 5) All outputs integrated with existing and emerging initiatives	<p>6.1 New geospatial products maximally informed and integrated with existing FI and SG geo-spatial data initiatives</p> <p>6.2 End of project synthesis workshop for FI and SG held by end Synthesis workshop held by end Quarter 3 FY 19/20 to decide how findings will</p>	<p><i>6.1 Review commenced in Q4 of first year. For completion in Year 2. Indicator should refer to both FI and SG, rather than two separate indicators for each Territory?</i></p> <p><i>6.2 For completion in Year 3 - Indicator is appropriate</i></p>

	contribute to systematic conservation planning	
Activity 6.1: Review all of the existing (relevant) stakeholder groups and data creation and management initiatives and protocols.		<i>Commenced in Q4 Year 1. For completion in Year 2.</i>
Activity 6.2: Produce a report on the review demonstrating how this initiative links to and builds on the existing and emerging work, and publish on the project webpage.		<i>For completion in next reporting period</i>
Activity 6.3: Prepare for and host 'end of project' synthesis workshop to decide how outputs will be fed into planning		<i>For completion in final reporting period</i>
Output 7. 7. Monitoring and evaluation	7.1 Detailed Monitoring and evaluation plan produced by end Quarter 4 FY 17/18 7.2 6-monthly updates on implementation of M&E Plan provided to PMG	<i>7.1 Completed - M& E plan produced in Q4 Year 1 – available from the project Trello page, and on request. Indicator is appropriate</i> <i>7.2 Planned for completion next reporting period – Indicator is appropriate</i>
Activity 7.1: Prepare monitoring and evaluation (M and E) plan		<i>Completed</i>
Activity 7.2: Prepare and present 6 monthly M and E updates		<i>For completion in next reporting period</i>
Activity 7.3: Upload M and E plan and updates onto webpages		<i>For completion in next reporting period</i>

Annex 2: Project’s full current logframe as presented in the application form (unless changes have been agreed) - if appropriate

N.B. if your application’s logframe is presented in a different format in your application, please transpose into the below template. Please feel free to contact Darwin-Projects@ltsi.co.uk if you have any questions regarding this.

Note that this is the revised and approved logical framework as opposed to the original logical framework.

Project summary	Measurable Indicators	Means of verification	Important Assumptions
<p>Impact: Environmental evidence-base for decision-making on the FI and SG is significantly enhanced by the provision of baseline data in a thematic area that is a current gap i.e. coastal margin.</p>			
<p>Outcome: The mapping generated from this cost-effective and innovative remote-sensing will underpin and enhance spatial and conservation planning in the remote FI and SG and allow for efficient, effective monitoring.</p>	<p>0.1 Coastal margin habitats are broadly classified and are visualized via digital outputs (e.g. maps, GIS layers) at spatial and temporal scale sufficient for spatial planning and decision making for FI and SG.</p>	<p>0.1 FI MSP Web GIS portal 0.2 SG webGIS portal 0.3 SAERI project webpages.</p>	<p>SAERI's IMS-GIS Centre continues to retain relevant skilled staff</p>
<p>Outputs: 1. Project Management structure, and communications tools established</p>	<p>1.1 Project Manager recruited by end Quarter 3 FY 17/18. 1.2 An MoU agreed and signed by all partners by end Quarter 4 FY 17/18. 1.3 A Project Management Group (PMG) meeting held every 3 months starting October 2017. 1.4 A Project Stakeholders group (PSG) meeting held every 6 months starting Quarter 4 FY 17/18. 1.5 At least 1 project webpage created by end Quarter 4 FY 17/18, and at least 1 update to the page made every month. 1.6 Final project report produced by March 2020.</p>	<p>1.1 Project Manager employment contract signed 1.2 MOU signed by all parties 1.3 PMG meeting notes available online 1.4 PSG meeting notes available online. 1.5 Project webpage available for viewing online</p>	<p>PM with the relevant skills can be recruited.</p>

<p>2. Work Package 1 WP1: Digitised 50 year old aerial imagery (FI only)</p>	<p>2.1 1 Commence geo-referencing of 1954 aerial imagery by Quarter 4 FY 17/18.</p> <p>2.2 Complete geo-referencing of 1954 aerial imagery to create a digital map by end Quarter 2 FY 18/19</p>	<p>2.1 1954 FI aerial imagery digital map available via MSP GIS portal</p>	<p>Aerial imagery is of sufficient quality to be able to be digitised. Preliminary checks suggest this is the case.</p>
<p>3. Work package 2 (WP2): Object based image analysis and habitat modelling of the coastal margin (FI and SG)</p>	<p>3.1 Stage I habitat modelling and classification complete for the Falklands by September 2018.</p> <p>3.2 Stage I habitat modelling and classification (terrestrial and intertidal) complete for South Georgia by end March 2018.</p> <p>3.3 Stage I habitat modelling and classification (subtidal) complete for South Georgia, and integration with terrestrial and intertidal habitat maps (3.2) by end July 2018</p>	<p>3.1 FI coastal margin (Stage I) habitat map available online via MSP GIS portal</p> <p>3.2 SG coastal margin (Stage I) habitat map available online via South Georgia GIS portal</p>	<p>Satellite imagery at useful resolution and without cloud cover is obtainable.</p> <p>Preliminary checks suggest several options and suitable imagery will be available.</p> <p>Satellite imagery and derived products are open access.</p> <p>Preliminary enquiries and expert opinion suggest this is feasible.</p>
<p>4. Work Package 3 (WP3): Identification, prioritisation and fulfilment of information data needs for the systematic conservation and planning of the coastal margin for the FI and for SG</p>	<p>4.1 At least 1 FI (Q3 FY 18/19) and 1 SG (Q3 FY 18/19) stakeholder workshop held to identify and prioritise data needs for the coastal margin</p> <p>4.2 Ground truthing of satellite imagery analysis on SG (Quarter 3 FY 17/18 & Quarter 4 FY 18/19) and the FI (Quarter 1 – Quarter 4 FY 18/19)</p> <p>4.3 Stage II geospatial data products reflecting prioritized information needs utilizing high res imagery to reduce uncertainty in habitat models/classifications and address spatial and temporal data priority needs expressed by stakeholders – for both the FI and SG by Quarter 1 FY 19/20</p>	<p>4.1 FI and SG stakeholder workshop report on the project page website</p> <p>4.2 FI coastal margin fine scale (Stage II) maps available online via FI MSP GIS portal.</p> <p>4.3 SG coastal margin fine scale (Stage II) maps available online via SG GIS portal</p>	<p>Satellite imagery at useful resolution and without cloud cover is obtainable. Preliminary checks suggest several options and suitable imagery will be available.</p> <p>Permissions to access study areas approved by landowners (where required).</p>

<p>5. Work Package 4 (WP4): Prioritisation of ongoing planning, protection and monitoring of the coastal margin</p>	<p>5.1 A monitoring manual produced for long-term monitoring of coastal margin for the Falklands by end Quarter 3 FY 19/20</p> <p>5.2 A monitoring manual produced for long-term monitoring of coastal margin for South Georgia by end Quarter 3 FY 19/20</p> <p>5.3 At least 1 face-to-face training workshop in implementing monitoring undertaken by end Quarter 2 FY 19/20</p>	<p>5.1 FI monitoring manual available on the project page website</p> <p>5.2 SG monitoring manual available on the project page website.</p> <p>5.3 Training workshop report available on project page website</p> <p>5.4 Televised training available online on project page website.</p>	<p>There are in-territory staff who are well-positioned to undertake the training.</p> <p>Discussions to identify where the future long-term monitoring role would sit for both islands are underway.</p>
<p>6. Work Package 5 (WP 5) All outputs integrated with existing and emerging initiatives</p>	<p>6.1 New geospatial products maximally informed and integrated with existing FI and SG geo-spatial data initiatives</p> <p>6.2 End of project synthesis workshop for FI and SG held by end Synthesis workshop held by end Quarter 3 FY 19/20 to decide how findings will contribute to systematic conservation planning</p>	<p>6.1 Report on integration with other initiatives on the FI published on the project webpage.</p> <p>6.2 Report on integration with other initiatives on the SG published on the project webpage.</p>	<p>Owners and co-ordinators of existing initiatives are willing to collaborate and explore these opportunities as well.</p> <p>The support of the project partnership brings on board key leaders in these areas.</p>
<p>7. Monitoring and evaluation</p>	<p>7.1 Detailed Monitoring and evaluation plan produced by end Quarter 4 FY 17/18</p> <p>7.2 6-monthly updates on implementation of M&E Plan provided to PMG</p>	<p>7.1 Detailed M&E Plan available on project webpage</p> <p>7.2 M&E updates available on project webpage</p>	<p>PM has skills to deliver M&E plan</p> <p>This will be built into the Job description of the PM and the ToRs of the PMG</p>
<p>Activities (each activity is numbered according to the output that it will contribute towards, for example 1.1, 1.2 and 1.3 are contributing to Output 1)</p> <p>1.1 Advertise, interview and recruit PM</p> <p>1.2 Draft and sign Project Partners MoU</p> <p>1.3 Quarterly PMG meetings</p> <p>1.4 6 monthly PSG meetings</p> <p>1.5 Monthly Webpage updates</p> <p>1.6 Complete various project management activities</p> <p>1.7 Final project report and publicity</p>			

- 2.1 Explore development of a workflow to aid the geo-referencing 1954 aerial imagery
- 2.2 Complete the geo-referencing of 1954 aerial imagery along the coastal margin
- 2.3 Produce a digital map of the 1954 aerial imagery showing the coastal margin
- 2.4 Upload the 1950's coastal margin (aerial imagery) map onto the MSP GIS portal and a copy of the associated metadata onto the South Atlantic metadata catalogue

- 3.1 Source the Satellite imagery for the Falklands and South Georgia
- 3.2 Pre-processing of satellite imagery to prepare for analysis
- 3.3 Undertake Analysis of the satellite imagery and habitat modelling
- 3.4 Produce a Coastal Margin habitat map for South Georgia and the Falklands
- 3.5 Upload the Coastal Margin habitat map onto the MSP GIS portal (for the Falklands) and supply SG map to GSGSSI (for upload to GSGSSI web portal); upload a copy of the associated metadata onto the South Atlantic metadata catalogue.

- 4.1 Confirm Stakeholder workshop (to identify and prioritise spatial and temporal data priority needs expressed by Stakeholders) date, venue, and participants for the Falklands and South Georgia
- 4.2 Confirm Stakeholder workshop programme, speakers and facilitators through consultations via the PMG and PSG for the Falklands and South Georgia
- 4.3 Host the Stakeholder workshop for the Falklands and South Georgia
- 4.4 Produce the Stakeholder workshop report for the Falklands and South Georgia and upload onto the project webpage
- 4.5 Acquire very high resolution satellite imagery (e.g. WorldView) and/or undertake drone missions to acquire high resolution imagery for priority areas requiring fine-scale mapping in South Georgia and the Falklands
- 4.6 Pre-process the imagery to prepare for analysis
- 4.7 Undertake analysis of the imagery.
- 4.8 Undertake ground-validation of analysed data on the Falklands and South Georgia
- 4.9 Produce detailed (Stage II) Coastal Margin habitat maps for priority areas for South Georgia and for the Falklands
- 4.10 Upload the detailed (Stage II) Coastal Margin habitat map onto the MSP GIS portal (for the Falklands) and supply to GSGSSI for upload onto the GSGSSI web portal. Upload a copy of the associated metadata onto the South Atlantic metadata catalogue.

- 5.1 Draft a long-term coastal mapping/monitoring manual for the Falklands and South Georgia and upload onto the project webpage
- 5.2 Confirm date, venue, and participants for the Falklands and South Georgia coastal mapping/monitoring training workshop
- 5.3 Undertake coastal mapping/monitoring training workshop
- 5.4 Record videos of training sessions and upload online onto the project webpage

- 6.1 Review all of the existing (relevant) stakeholder groups and data creation and management initiatives and protocols.
- 6.2 Produce a report on the review demonstrating how this initiative links to and builds on the existing and emerging work, and publish on the project webpage.

6.3 Prepare for and host 'end of project' synthesis workshop to decide how outputs will be fed into planning

7.1 Prepare monitoring and evaluation (M and E) plan

7.2 Prepare and present 6 monthly M and E updates

7.3 Upload M and E plan and updates onto webpages

Annex 3:

Blog from the Nov/Dec 2017 DPLUS065 Coastal Mapping expedition to South Georgia published on the SAERI website² on 22nd November 2018 (**Double click on the outline below to open the embedded PDF of the article**)

Mapping the extraordinary habitats of South Georgia | SAERI

[http://www.south-atlantic-research.org/blog/mapping-the-extraordinary-h...](http://www.south-atlantic-research.org/blog/mapping-the-extraordinary-habitats-of-south-georgia/)

Mapping the extraordinary habitats of South Georgia

Posted on November 22, 2017 by Tara Pelembe



Pop pop pop pop pop. That seems to be the noise that a shabbered glacier makes as the tiny pieces of ice float out into the bay that it spills in to. It is a still day and this is the nose-filling Royal Bay, the site we're currently visiting. Like a million thousand year old ice cubes melting in a gin and tonic that is 5km wide.



— Peter's Glacier Ocean Bay
©SAERI

Royal Bay is our twelfth location that we have visited as part of an ambitious joint project to map the habitats of South Georgia. All being well we have a good twenty locations to go.

We are here to record the variety and extent of animal and botanical land habitats around the frozen interior of the island. We are armed with some simple tools: a white 30cm ruler, a pocket camera, a clip board (importantly, with water proof cover), pencils (also waterproof) and a 'GPS' navigation gizmo. (Okay, GPS isn't altogether simple.)

We have been tramping up and down hills, through waist-high swampy Tussock grass, across fragrant herbfields made of Bumet with its sticky bums, and gingerly along beaches with perpetually angry Fur Seals and -mostly- plaidd Elephant Seals.

Several sets of major influences are causing South Georgia's habitats to change. A changing climate is arguably the most systemic. However, introduced Reindeer used to graze large regions, and Norway rats and house mice, also introduced, have until recently preyed on birds, insects and eaten vegetation.

It is striking how much influence the presence of animals has on habitats here. Burrowing birds from the petrel family can transform a hillside into a highly fertile Tussock habitat with their faeces. So no rats may mean more birds, meaning more fertilisation, meaning recovering habitats.



² <http://www.south-atlantic-research.org/blog/mapping-the-extraordinary-habitats-of-south-georgia/>

Annex 4:

Coastal Mapping project article in the South Georgia Association Newsletter (No. 34 – April 2018). Go to Page 12. **Double click on the outline below to open the embedded PDF.**

South Georgia Association Newsletter

Number 34, April 2018

Website: www.southgeorgiaassociation.org ISSN: 1747-430

Facebook: www.facebook.com/southgeorgiaassociation



The Spring Meeting & AGM will be on April 20, 2018



A harpoon cannon ready to fire. The gunner or 'skytter' (pronounced 'sbooster') takes aim along the sighting rod.

Spring meeting and AGM

Members will have had an email with the details and booking form and this is a reminder.

The event is held at The Royal Over-Seas League, Over-Seas House, Park Place (off St James Street), London SW1A 1LR and starts with a pay bar opening from 5:45 pm. The Reception with wine and canapés starts at 6:00 pm. The AGM starts at 7:00 and at 8:00 pm there will be a talk by Dr Mark Brandon, Reader in Polar Oceanography, The Open University, on 'Giant Icebergs and South Georgia'. Mark Brandon did his PhD at the Scott Polar Research Institute before moving to the British Antarctic Survey, and The Open University. He has written more than 40 research articles and three textbooks.

In recent decades several giant icebergs have passed close by South Georgia, the most recent being a remnant of B09 that calved from Ross Ice Shelf in 1987. Oceanographic data shows the impact of the bergs on local melt and how regional waters are affected. During his talk, Mark will use material from the TV series Frozen Planet and Blue Planet 2 for which he was an academic advisor.

Grand Summer Barbecue on the Thames



HMS Wellington (U65) was a Grimsby-class sloop launched in 1934. After World War II she was converted to "Head Quarters Ship" HQS Wellington at Chatham Dockyard. Since December 1946 she has been moored at Temple Stairs, Victoria Embankment, where she serves as the floating Livery Hall of the Honourable Company of Master Mariners. She is a superb venue affording wonderful views of the tidal Thames. Click on the link <http://www.thewellingtontrust.com/home>

Annex 5:

Summary of habitat modelling methodology used to develop a broad scale (Stage 1) coastal habitat map for South Georgia

Lead partner: Oregon State University.

Background

The focus of Work Packages 2 and 3 are to develop broad scale (and subsequently fine scale) coastal habitat maps for the Falklands and South Georgia. While modelling using Earth Observation data is often intensive, with large file sizes, due consideration needs to be given to the location of Territories, acknowledging that connectivity/bandwidth is limited. Therefore, it was important that any habitat modelling methodologies being developed through the project took advantage of 'cloud-based' systems, negating the requirement to transfer large remote sensing datasets to the Falklands. This point is particularly critical from a legacy perspective, ensuring that a cost-effective system is developed, which can be used long after the project has come to a close.

The approach adopted

Following project partner meetings in early January '18, an approach similar to that trialled under the [Living Maps](#) project was adopted. However, whereas the Living Maps methodology was coded in 'R', it was recognised that there were significant advantages of using a cloud-based platform, so Google Earth Engine (GEE) was used, necessitating some re-coding in Javascript. However, the principles of using a supervised classification/Random Forest approach were retained, noting that other classification and modelling methods may be explored through the project.

Link to current project Earth Engine script:

<https://code.earthengine.google.com/3c7af9bae881278501560d60ba84a524>

The following input layers were used in creating the broad scale (Stage 1) coastal habitat for South Georgia:

- Processed Sentinel-2³ data (supplied by JNCC) (Terrain corrected) – the benefit of using GEE is that the latest Earth Observation datasets can be pulled into the model – for example after the project has finished and end users require the habitat maps to be updated.
- Slope (derived from SRTM⁴)
- Aspect (derived from SRTM³)
- Elevation (derived from SRTM³)
- Ground validation data (split between 'training' and 'validation' datasets) - These ground validation points are primarily what was collected during the Nov/Dec 2017 field expedition to South Georgia, and consists of an observation of the ground cover/habitat at a particular location (latitude/longitude) along with a set of photographs showing the general ground cover/plant life etc at that location.

Where possible, cloud-free satellite images were sourced for the analysis. However, for locations where cloud is a persistent feature (such as South Georgia), some cloud correction/masking was required and applied.

When the model is run, a subset of the ground validation data points (called 'training points') are used to train the computer software to recognise particular 'signatures' from the various input layers listed above as particular 'habitat classes'. It is then possible to predict and classify the remaining mapped area using these habitat classes. Testing the accuracy of these predictions

³ <https://sentinel.esa.int/web/sentinel/missions/sentinel-2>

⁴ <https://www2.jpl.nasa.gov/srtm/>

is important. Therefore, the remainder of the ground validation data points (known as ‘validation’ points) are used to test whether the predicted ‘habitat class’ matches reality. A standard way of doing this is the creation of ‘confusion matrices’, and these have been produced for the maps being created under this project. The resultant habitat maps showing a restricted number of vegetation classes along with associated confusion matrices can be seen in Fig 5.1a, 5.1b & Table 5.1, whilst habitat maps and associated confusion matrices for a full range of vegetation classes can be seen in Fig 5.2a, 5.2b & Table 5.2.

Potential future improvements to consider

Histograms, scatterplots, and statistical reporting – GEE has the potential to provide customizable histograms and scatterplots based on bands, classes, areas of interest, and so forth. It is also possible to create text output of statistics based on classification type, bands, region of interest, and so on. Input from other researchers regarding their preferences for specific types of statistical reporting (whether graphically or numerically based) may be useful in better tailoring useful statistics outputs for this project.

Additional digitized data inputs – it is likely possible to supply further hand-digitized sample points for at least some vegetative classes (example: low veg typically has fairly dark green coloration and uniformly dense and smooth texture in the input Sentinel data and the GEE basemap imagery along with a strong NDVI response). Further input from researchers knowledgeable in these vegetation classes would be of great use in expanding the hand-digitized component of the training and validation datasets.

Additional ground-validation points in general – It is recommended that additional ground validation points are collected during the planned Feb/March 2019 expedition to South Georgia. Specific habitat classes would greatly benefit from being targeting, and these maps now allow us to identify where sampling can be best prioritised.

South Georgia: Earth Engine Random Forest Classification Single Comprehensive Vegetative Class

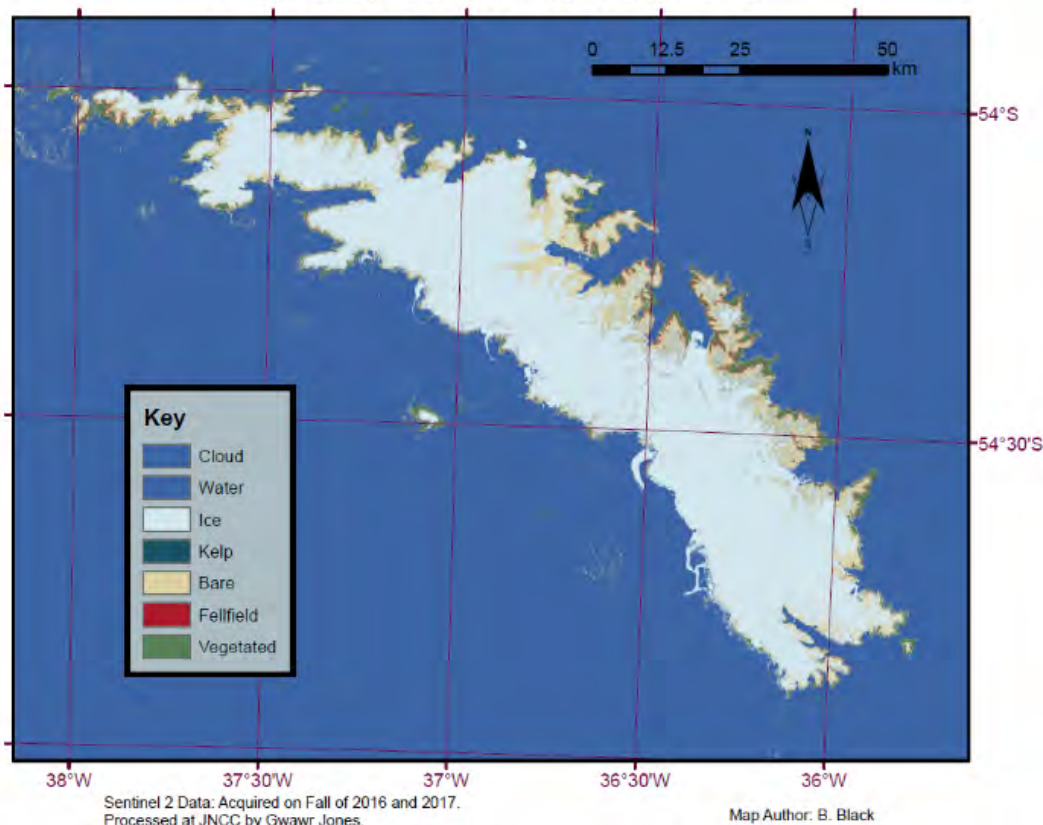


Fig 5.1a: 0 = Cloud, 1 = Water, 2 = Ice, 3 = Kelp, 4 = Bare, 5 = Fellfield, 6 = Vegetation

South Georgia: Earth Engine Random Forest Classification

Closeup: Single Comprehensive Vegetative Class

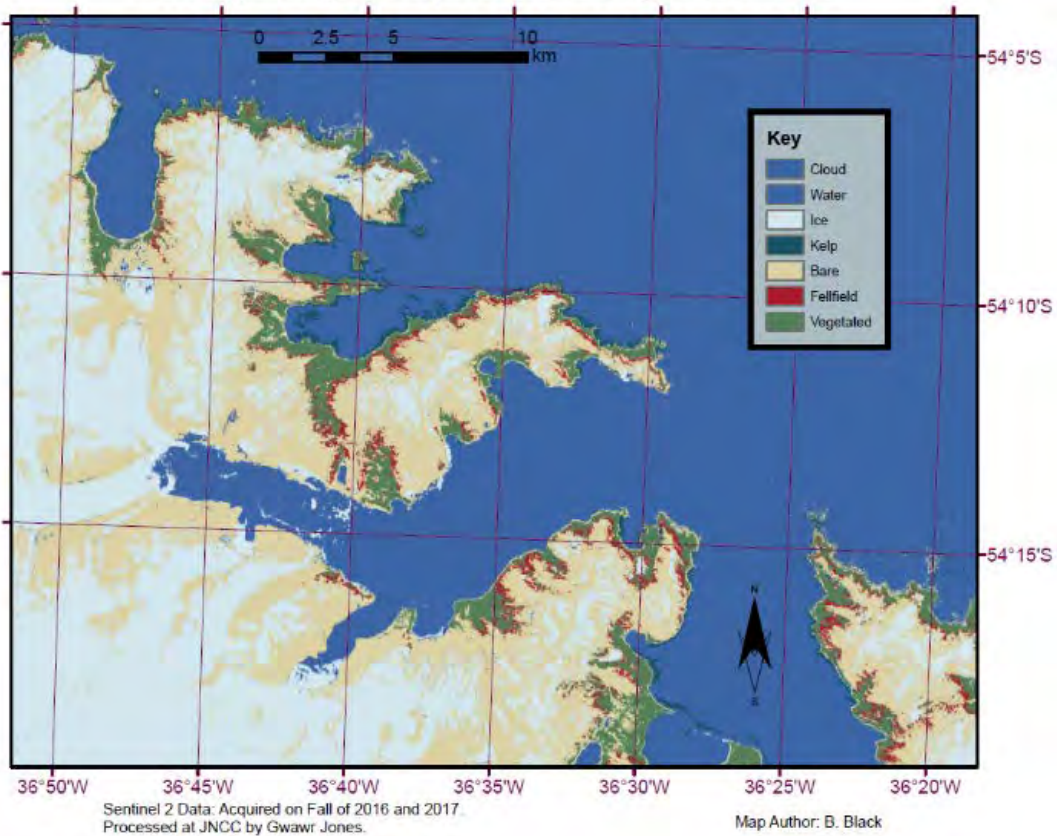


Fig 5.1b: 0 = Cloud, 1 = Water, 2 = Ice, 3 = Kelp, 4 = Bare, 5 = Fellfield, 6 = Vegetation

Training Overall Accuracy: (0.9907)							
	0	1	2	3	4	5	6
0	52						
1		203		1			
2		1	140				
3		2		61			
4					133		1
5						14	1
6					1		139

Validation Overall Accuracy: (0.8292)							
	0	1	2	3	4	5	6
0	49	2			3		
1	1	173	19	1	9		1
2	1	6	131	1	5		1
3		7		55	1		
4		8	5		82		16
5		1	1		8		15
6					11		107

Table 5.1: Training and Validation accuracy (confusion) matrices for single comprehensive vegetative class.

South Georgia: Earth Engine Random Forest Classification

Six Vegetative Classes, Including Fertilized and Unfertilized Tussac

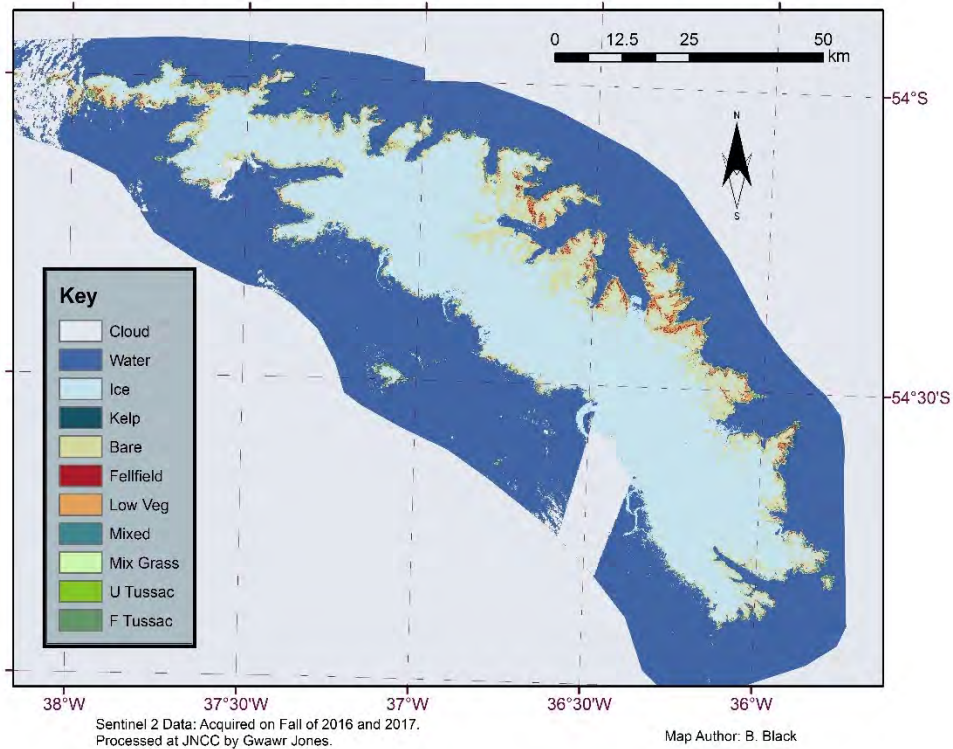


Fig 5.2a: 0 = Cloud, 1 = Water, 2 = Ice, 3 = Kelp, 4 = Bare, 5 = Fellfield, 6 = Low growing veg, 7 = Mixed grass and low growing veg, 8 = Mixed grasses, 9 = Unfertilized tussac, 10 = Fertilized tussac

South Georgia: Earth Engine Random Forest Classification

Six Vegetative Classes, Including Fertilized and Unfertilized Tussac

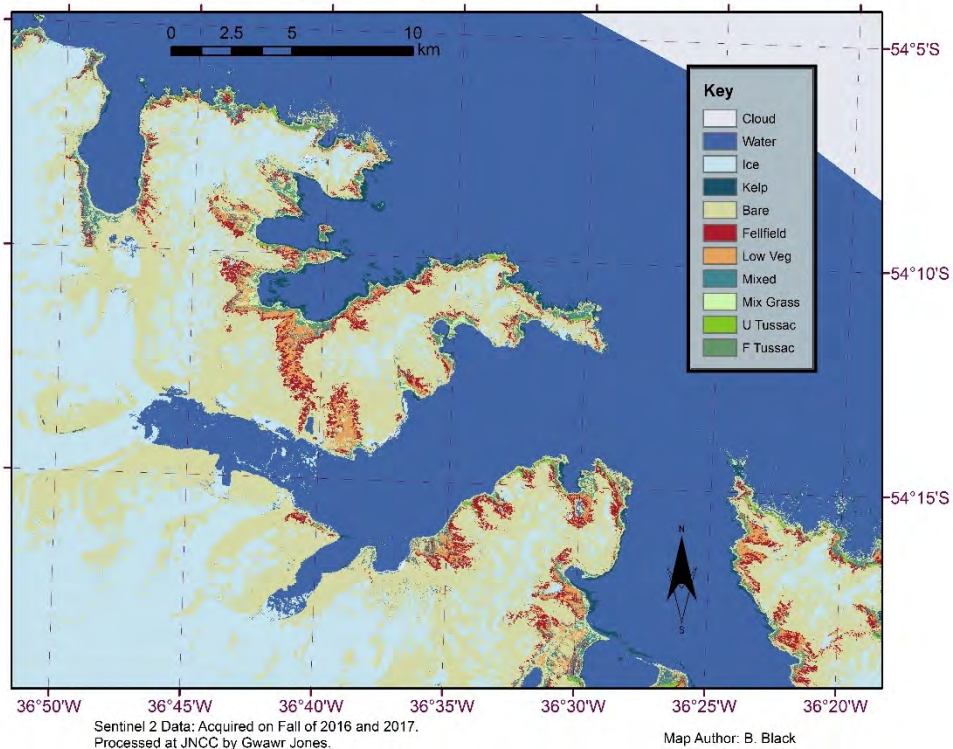


Fig 5.2b: 0 = Cloud, 1 = Water, 2 = Ice, 3 = Kelp, 4 = Bare, 5 = Fellfield, 6 = Low growing veg, 7 = Mixed grass and low growing veg, 8 = Mixed grasses, 9 = Unfertilized tussac, 10 = Fertilized tussac

Training Overall Accuracy: (0.9922)											
	0	1	2	3	4	5	6	7	8	9	10
0	57										
1		212			1						
2		1	149								
3		2		61							
4					123						
5						15					
6							21				
7					1			61			
8					1				28		
9										12	
10											27

Validation Overall Accuracy: (0.7401)											
	0	1	2	3	4	5	6	7	8	9	10
0	45	2	1		1						
1	1	179	4	1	10						
2		6	121	1	7				1		
3		6	1	54	2						
4	1	14	4	2	90			10			1
5		1	1		12	1		8	1		1
6					2	1	5	13	2		3
7					11	1	1	28	4		2
8					4		1	15	6		4
9								4		0	1
10				2	3			13	3	1	15

Table 5.2: Training and Validation accuracy (confusion) matrices for six vegetative classes.

Annex 6:

Coastal Mapping project 'Earth Observation Field Survey Protocol' document. Double click on the outline below to open the embedded PDF

Earth Observation Field Survey Protocol

PREPARED BY

Dr Gwawr Jones, Earth Observation Specialist (JNCC)
Dr Laria Marengo, Project Manager – GIS Specialist (SAERI)

DATE

26/10/2017

VERSION NUMBER

V0.2

EMAIL:

earthobs@jncc.gov.uk



Annex 7:

Coastal Mapping project outreach document. Double click on the outline below to open the full PDF

DPLUS065 Coastal Mapping project outreach: Facebook and Twitter handles

Project hashtag: #SouthAtlanticCoastalMapping

DigitalGlobe Foundation

@DigitalGlobeFDN (Twitter)

@digitalglobefoundation (Facebook)

Any use of the images in hardcopy print or broadcast must include the following credit reasonably displayed next to or on the image: "Satellite image(s) courtesy of the DigitalGlobe Foundation". Any use of the images published on the World Wide Web must include the following words, reasonably displayed: Copyright © 20XX DigitalGlobe Foundation or Satellite image courtesy of the DigitalGlobe Foundation. Wherever possible, the word "DigitalGlobe Foundation" must be hot-linked to the DigitalGlobe Foundation website (www.digitalglobefoundation.org). Each image must be individually attributed.

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@DarwinInitiative (Facebook)

SAERI

@SAERI_FI (Twitter)

@SAERI (Facebook)

Oregon State University

@oregonstate & @oregonstategeog (Twitter)

@osubeavers & @oregonstategeography (Facebook)

Joint Nature Conservation Committee

@JNCCUK (Facebook)

@JNCC_UK (Twitter)

Government of South Georgia and the South Sandwich Islands

@GovSGSSI (Twitter)

@GovSGSSI (Facebook)

Falkland Islands Government

@FalklandsGov (Twitter)

@FalklandsGov (Facebook)

Shallow Marine Surveys Group

@shallow_marine (Twitter)

@shallowmarinesurveys (Facebook)

Checklist for submission

	Check
Is the report less than 10MB? If so, please email to Darwin-Projects@ltsi.co.uk putting the project number in the Subject line.	No
Is your report more than 10MB? If so, please discuss with Darwin-Projects@ltsi.co.uk about the best way to deliver the report, putting the project number in the Subject line.	Yes
Have you included means of verification? You need not submit every project document, but the main outputs and a selection of the others would strengthen the report.	Yes
Do you have hard copies of material you want to submit with the report? If so, please make this clear in the covering email and ensure all material is marked with the project number.	Included as embedded PDFs
Have you involved your partners in preparation of the report and named the main contributors	Yes
Have you completed the Project Expenditure table fully?	Yes
Do not include claim forms or other communications with this report.	