Using OGC API standards for marine data delivery: MEDIN Pilot Project

Technical Report for Marine Environmental Data and Information Network (MEDIN)

Open Report OR/22/079

BRITISH GEOLOGICAL SURVEY

MEDIN TECHNICAL REPORT

Open Report OR/22/079

Using OGC API standards for marine data delivery: MEDIN Pilot Project

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Editor

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Keywords

Marine, Geology, OGC, API, OGC API, OGC API - EDR

Bibliographical reference

C Blackburn, E Lewis, M Mowat, M Nayembil, A Richardson, J Stevenson, 2023.
Using OGCAPI standards for marine data delivery: MEDIN Pilot Project. *British Geological Survey Internal Report*, OR/22/079. 28pp.

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Keyworth, Nottingham British Geological Survey 2023

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Foreword

This report is the published product of a pilot project by the British Geological Survey (BGS), commissioned by Marine Environmental Data and Information Network (MEDIN) to investigate the implementation of the OGC API – Environmental Data Retrieval (OGC API – EDR) standard to deliver data externally from the MEDIN Geology and Geophysics Data Archive Centre (DAC).

The report details the method and technologies used in the attempt to deliver BGS DAC data using the OGC API – EDR standard, ultimately resulting in data being served using OGC API – Features with Common Query Language (CQL) Functionality.

This report could be used as an OGC API implementation guide for other DACs and as guidance on contributing to existing Open-Source projects.

The report also detail aspects of the OGC API – EDR that made it inappropriate to use for some marine environmental data, and any areas where the standard was ambiguous or challenging to implement.

Also included are recommendations on how well the OGC API – EDR can support direct access to data for MEDIN, including which data types/formats can be supported.

Acknowledgements

Many individuals external to BGS have contributed to the project. This assistance has been received at all stages of the study. Many individuals have freely given their advice and provided their knowledge and understanding of the OGC API standards & target application so important to the delivery of this project. We would particularly like to thank the following:

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Summary

This report is the published product of a pilot project by the British Geological Survey (BGS), commissioned by Marine Environmental Data and Information Network (MEDIN) to investigate the implementation of the OGC API – Environmental Data Retrieval (OGC API – EDR) standard to deliver data externally from the MEDIN Geology and Geophysics Data Archive Centre (DAC).

The report details the method and technologies used in the attempt to deliver BGS DAC data using the OGC API – EDR standard.

This report could be used as an OGC API implementation guide for other DACs and as guidance on contributing to existing Open-Source projects.

The report also detail aspects of the OGC API – EDR that made it inappropriate to use for some marine environmental data, and any areas where the standard was ambiguous or challenging to implement. Also included are recommendations on how well the OGC API – EDR can support direct access to data for MEDIN, including which data types/formats can be supported.

BGS did not have sufficient resource to deliver an OGC API – EDR endpoint at the completion of the project but did implement OGC API – Features with Common Query Language (CQL) endpoint which offers similar functionality but uses different syntax. OGC API – Features + CQL was meant to be an intermediary step to delivering OGC API – EDR. BGS were unable to deliver OGCI – EDR as after spending time exploring the standard in depth it was shown to be more complex than anticipated. However, through the process of this endeavour we have made incremental steps forward towards EDR, and we were able to make a major contribution to an Open-Source Project which will benefit many geospatial data publishers and users.

1 Introduction

MEDIN's vision is that all UK marine data are Findable, Accessible, Interoperable and Reusable (FAIR). A key objective for MEDIN is to support the UK marine sector to implement globally and cross-domain interoperable marine data services e.g., machine-readable Application Programming Interfaces (APIs) for our Data Archive Centres (DACs) and others. This report describes the results from a pilot project undertaken by The British Geological Survey to investigate the implementation of the OGCAPI-Environmental Data Retrieval (OGCAPI-EDR) standard to deliver data from the MEDIN Geology and Geophysics Data Archive Centre (DAC) via the Open Geospatial Consortium (OGC) API - Features standard with CQL.

The vision of the project was ambitious and turned out to be more complex than anticipated. However, through the process of making incremental steps towards implementing the OGC API – EDR standard, we were able to make a major contribution to an Open-Source Project which will benefit many geospatial data publishers and users. In turn, it is hoped this will increase uptake and adoption of the OGC API suite of standards, including OGC API – EDR.

Two other DACs (Cefas and DASSH) were also working in parallel with the same aims for their own data holdings.

1.1 CURRENT DATA ACCESS

BGS currently make our DAC data available through a variety of routes:

- Direct File Download (Variety of formats - GeoPackage, CSV, ESRI, MapInfo)
- OGC Standard web services – Web Mapping Services (WMS), Web Feature Service (WFS).
- Geoportals – GeoIndex Offshore (Figure 1)
- Online Viewers – Scans of Maps, Logs, Notebooks, Geophysical Data, Photos
- Deposited Data Search of the National Geoscience Data Centre (NGDC)

These delivery mechanisms are facilitated through bespoke code for data extraction and packaging, and via OGC Web Services (Web Map Services, Web Feature Services) published using ESRI Server. The OGC Web Services are publicly advertised and are available for end users to incorporate into their own visualisations or analysis.

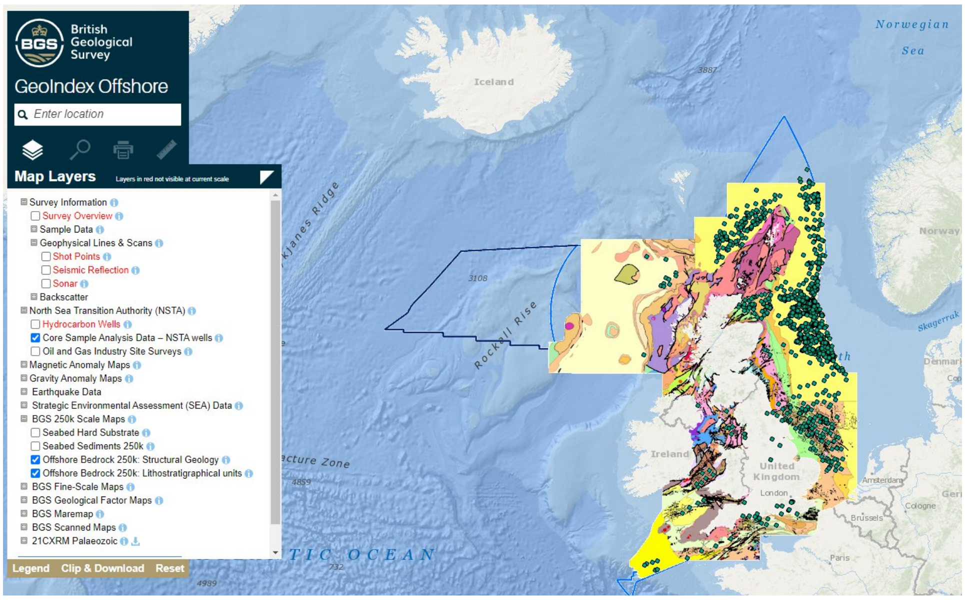

Figure 1. GeoIndex Offshore Geoportal view[1]

[1] British Geological Survey © UKRI. Basemap Sources: Esri, GEBCO, DeLorme, NaturalVue | Esri, GEBCO, IHO-IOC GEBCO, DeLorme, NGS

1.2 ENABLING DIRECT ACCESS TO DATA FROM DISPARATE DATA ARCHIVE CENTRES USING THE OGC EDR API STANDARD.

Since 2016, MEDIN has encouraged its Data Archive Centres to make it easier for users to gain direct access to the datasets that they find on the MEDIN portal. Users of the portal are frustrated when they cannot go directly to data from a search. Several DACs have made technological changes to their systems to enable direct access, but to date there has not been a consistent approach across the MEDIN DACs.

MEDIN funding (matched by DACs themselves) was provided to BGS to implement the OGC API – EDR standard for their data holdings to trial how the standard works for disparate marine data and provide feedback to MEDIN and the OGC in order to help the wider UK marine community understand the implications and benefits of adopting the OGC API – EDR.

The overall aim for this work was to streamline access to UK marine data and this pilot helped improve understanding as to whether the OGC API – EDR may be the appropriate means to do so.

1.3 WHAT ARE THE OGC API STANDARDS?

The OGC API suite of standards are a modular collection of web focused, OpenAPI based standards building on the legacy of the older OGC Web Service Standards (WMS, WMTS, WFS, etc.)[2]. These new standards include:

- OGC API-Common
- OGC API-Records
- OGC API-Features
- OGC API-EDR
- OGC API-Tiles
- OGC API-Maps
- OGC API-Coverages
- OGC API-Processes
- OGC API-Styles

These are built around modern web API best practice, using REST/JSON/OpenAPI in line with the Spatial Data on the Web Best Practices[3].

1.3.1 What is OGC API – Features?

OGC API – Features specifies the fundamental API to create, modify and query geospatial features on the Web directly. Responses are typically in JSON and HTML although other encodings are permissible.

Geospatial features in this context are limited to vector data such as polygons, points and linestrings.

1.3.2 What is Common Query Language (CQL)?

"A fundamental operation performed on a collection of features is that of filtering in order to obtain a subset of the data which contains feature instances that satisfy some filtering criteria.

Part three of the OGC API - Feature Standard defines:

- Query parameters (filter, filter-lang, filter-crs) to specify filter criteria in a request to an API.
- A filter grammar called Common Query Language (CQL) for specifying enhanced filtering criteria beyond what is supported in the Core.

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[2] https://ogcapi.ogc.org/
[3] https://www.w3.org/TR/sdw-bp/

- Two encodings for CQL - a text and a JSON encoding.” [4]

It can be compared to Structured query language (SQL), a programming language for storing and processing information in a relational database, whereas CQL is to be applied to geospatial web services and API’s.

1.3.3 What is OGC API – EDR?

The OGC API – Environmental Data Retrieval standard is part of the OGC API suite of standards and extends OGC API – Features with additional query types like “Area”, “Location” and “Instance”.

1.4 WHY DOES MEDIN WANT TO IMPLEMENT THE OGC EDR API STANDARD?

MEDIN wants to recommend an API standard for the UK marine community to facilitate interoperability, thereby increasing access to the UK’s marine data resources. That standard must meet the specific needs of the marine community and MEDIN wants to ensure that the recommended standard is interoperable internationally and cross domain, recognising that the oceans, seas, atmosphere, cryosphere and land are interconnected and interdependent. Moreover, we want to avoid duplicating work carried out elsewhere.

1.5 PROJECT PLAN

BGS Summary project plan tasks outlined below:

I. Choose an existing Free Open-Source Software (FOSS) platform to work with.

II. Add data to BGS internal database if not present.
   - A. Some data was currently in file folders in proprietary formats.

III. Make OGCAPI-Features available (23 Collections)
   - A. https://ogcapi.bgs.ac.uk/

IV. Add Common Query Language (CQL) functionality.

V. Add EDR functions (using templated CQL functions)
   - A. Area
   - B. Radius
   - C. Corridor

VI. Create Pull Request to add our code to the source software.

We were able to deliver items 1 – 4 and 6 in the period of this project, with MEDIN funding allowing us to make a significant contribution to a widely used piece of free and open-source software (FOSS). We’ve also made large steps towards task 5 which will hopefully be achieved in the future.

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[4] https://docs.ogc.org/is/17-069r3/17-069r3.html

2 Infrastructure and technologies used

BGS operate a mixed computing architecture including self-hosted cloud infrastructure with Kubernetes. We therefore had to develop an application which fitted with this architecture and our maintenance capacity, particularly as we wanted to develop and implement a production system.

2.1 REQUIREMENTS

We chose the following criteria, aligning to government development guidance in the Technology Code of Practice[5]:

- Development should be open source.
- Ideally contribute to an existing open-source project.
  - Project should have good community backing.
- Database Connection – Oracle or PostgreSQL
- Python based application.
- Modular – allowing plugins.
- Containerised
  - Suitable for deployment on Kubernetes

These requirements led us to selecting "pygeoapi" as the software / project we would contribute to.

2.2 PYGEOAPI

Pygeoapi is a Python server implementation of the OGC API suite of standards and has been Certified OGC Compliant and an OGC Reference Implementation for OGCAPI-Features and OGC API – EDR.

However, the existing software only served OGC API – EDR when connected to an xarray or netCDF file. The OGC API – Features endpoint only allows complex CQL queries when using an elasticsearch backend.

Pygeoapi is one of the Open-Source Geospatial Foundation (OSGeo) projects and is Open Source under MIT licence. The software is used at Meteorological Service of Canada, Istituto Superiore per la Protezione e la Ricerca Ambientale (ISPRA) & US Geological Survey (USGS).

There is also a broad international team (Canada, Netherlands, Greece, Italy, New Zealand, United States, Spain) of core contributors which we recognised as vital for the long-term sustainability of the project.

Configuration is streamlined with only a single .yml file to edit & deployment suited to our infrastructure, with official Docker images available.

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[5] https://www.gov.uk/guidance/the-technology-code-of-practice

3 Data selection – methodology and description

BGS manages seabed and sub-seabed marine geoscience survey data and is the accredited Marine Environment Data and Information Network (MEDIN) data archive centre (DAC) for geology and geophysics.

The data is made accessible via online geoportals (GeoIndex Offshore - https://www.bgs.ac.uk/map-viewers/geoindex-offshore/), Web Map Services (OGC WMS), Deposited Data Search of the National Geoscience Data Centre (NGDC) and physical collections in the National Geological Repository (NGR).

We chose to make all Open Government Licenced data accessible via the Offshore GeoIndex available using OGC API standards as part of this project. This totalled 23 datasets (Appendix 1) which are now all available on https://ogcapi.bgs.ac.uk/

Data collections include:

- Marine sample data (boreholes, core, grab, dredge, and other samples)
- Geophysical survey data
- Map indexes
- Geological factor maps
- Offshore hydrocarbon wells

To ensure data quality and consistency we used the same source data table in the BGS Oracle database as used by the GeoIndex Offshore application, ensuring end users receive the same data on all platforms.

4 Technical Implementation

Our work has been accepted into the main pygeoapi repository, extending the functionality of the software significantly.

- Code: https://github.com/geopython/pygeoapi
- BGS Work: https://github.com/geopython/pygeoapi/pull/964 (126 Commits)
- Production Server: https://ogcapi.bgs.ac.uk/ (Figure 2)

Initially we setup a meeting with the core pygeoapi developers to confirm that the work we wanted to do would be in line with their own roadmap for the software and to confirm some of the application architecture before making any changes.

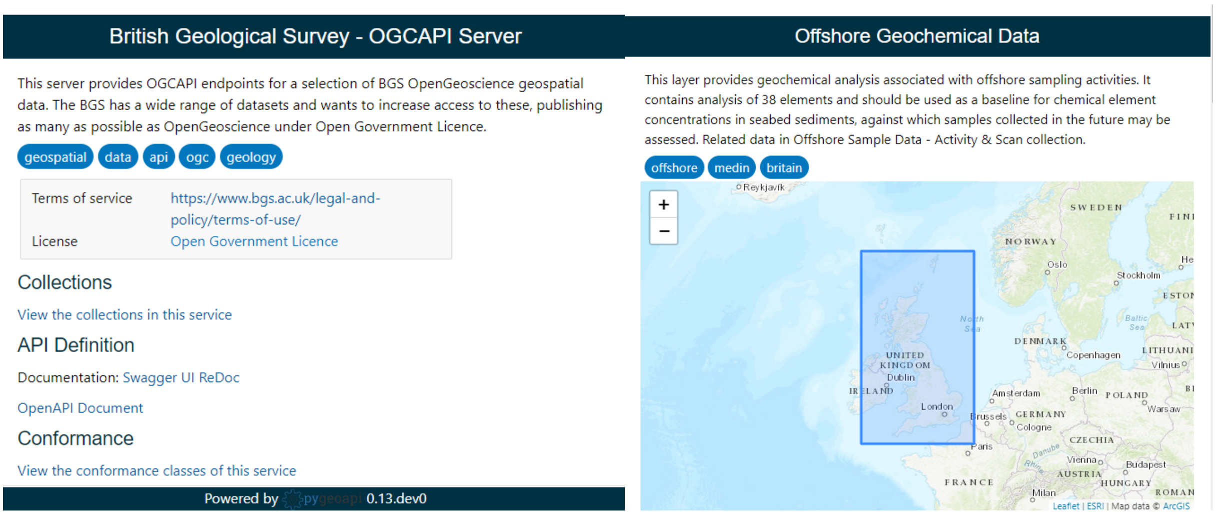

Figure 2. BGS OGCAPI Server Home Page and Data Collection (Offshore Geochemical Data) Page.

4.1 DATABASE

BGS authoritative corporate data is held in an Oracle database, however pygeoapi doesn't offer an Oracle database connection.

BGS also use PostgreSQL + PostGIS database as required, such as for this project. We had to find a solution to copy data from Oracle to PostgreSQL with daily/weekly/monthly updates as the data required:

- Daily
  - Earthquakes
- Weekly
  - Boreholes
- Monthly
  - All other data collections

This was achieved using Flyway to create appropriate tables in PostgreSQL:

- Foreign Data Wrappers (FDW) to the Oracle Tables
- Materialised Views of those FDW
  - With scheduled refresh depending on the data collection.

4.2 OGCAPI – FEATURES

Pygeoapi allowed us to setup an OGCAPI-Features endpoint very quickly, connecting to our PostgreSQL instance, however with very limited filter options, such as Bounding Box, Sort By and Skip Geometry.

4.3 CQL FUNCTIONALITY

To improve this and a stepping stone to achieving OGC API – EDR we needed to add CQL query functionality.

"Fundamental operation performed on a collection of features is that of filtering in order to obtain a subset of the data which contains feature instances that satisfy some filtering criteria."

- Filter using
  - Comparisons (equals, like, between, in, <, >)
  - Spatial (intersects, crosses, contains etc)
  - Temporal (before, between)

4.3.1 CQL examples

CQL allows queries like Get Boreholes in a polygon area where ags_log_url (URL to view graphical log for an AGS borehole) equals IS NOT NULL and has a length between 20 and 50 m:

https://ogcapi.bgs.ac.uk/collections/onshoreboreholeindex/items?f=json&filter=INTERSECTS%28shape,POLYGON%28%28-4.724%2050.238,-5.021%2050.351,-5.394%2050.393,-5.735%2050.238,-5.812%2050.041,-5.416%2049.921,-4.988%2049.886,-4.724%2050.238%29%29%29%20AND%20ags_log_url%20IS%20NOT%20NULL%20AND%20length%20BETWEEN%2010%20AND%2050&limit=10000

4.3.2 OGC API – Features + CQL vs OGC API – EDR comparison

The goal of this project was to evaluate the use of standard APIs to streamline access to UK marine data. As shown below, although the syntax isn't identical, a user could use OGC API – Features endpoints to extract data from BGS to combine with data from other DAC's requested via OGC API – EDR.

4.3.2.1 OGC API-Features + CQL

Get all sea sediment data, in X area:

https://ogcapi.bgs.ac.uk/collections/offshore-seabed-sediment-data/items?filter=INTERSECTS(shape,POLYGON((-4.724%2050.238,-5.021%2050.351,-5.394%2050.393,-5.735%2050.238,-5.812%2050.041,-5.416%2049.921,-4.988%2049.886,-4.724%2050.238)))&limit=10

4.3.2.2 OGC API-EDR

EDR allows a more user-friendly and shorter query syntax without needing to know CQL filter predicates, however the output would be identical, see the example below (this will not work on our system):

https://ogcapi.bgs.ac.uk/collections/offshore-seabed-sediment-data/area?coords=POLYGON((-4.724%2050.238,-5.021%2050.351,-5.394%2050.393,-5.735%2050.238,-5.812%2050.041,-5.416%2049.921,-4.988%2049.886,-4.724%2050.238)))&limit=100

4.4 DOCUMENTATION

Updates also had to be made to the pygeoapi documentation to reflect the changes in performance for users also using a PostgreSQL data connection.

We have also written BGS documentation and code examples using Jupyter Notebooks for how to interact with the OGCAPI service.

Source Code: https://github.com/BritishGeologicalSurvey/BGS-Product-API-Documentation

Rendered Documentation: https://britishgeologicalsurvey.github.io/BGS-Product-API-Documentation/#/

4.4.1 Accessing data in GIS

One of the advantages of using widely adopted standards is the availability of support from both servers and clients, including GIS software. The leading providers have already built in support for OGC API – Features services.

No GIS packages explicitly support OGC API – EDR. However, if and endpoint it offers an `items` response (this is optional in the OGC API – EDR standard but mandatory in OGC API - Features) then EDR could be used in the same way as a Features endpoint by GIS platforms, see 4.4.1.1 and 4.4.1.2.

The ability to connect using GIS offers several advantages:

- Wide user base
- “Live” link to data
- Useful for dynamic/frequently updated datasets
  - Saves repeat downloading
  - Always using the most current data

4.4.1.1 ESRI ArcPro

OGCAPI-Features has built in support in ArcPro. Services can be added using the “Connections” button, as shown in Figure 3 (pro.arcgis.com).

Connections > Server > New OGC API Server

Figure 3. ArcPro OGCAPI-Features Connection Workflow.

4.4.1.2 QGIS

QGIS also has native support for connecting to OGCAPI-Features services. Summary instructions for adding a service are in Figure 4 (QGIS.org).

1. Click the Open Data Source Manager button.
2. Enable the **WFS / OGC API - Features** tab.
3. Click the **New** button.

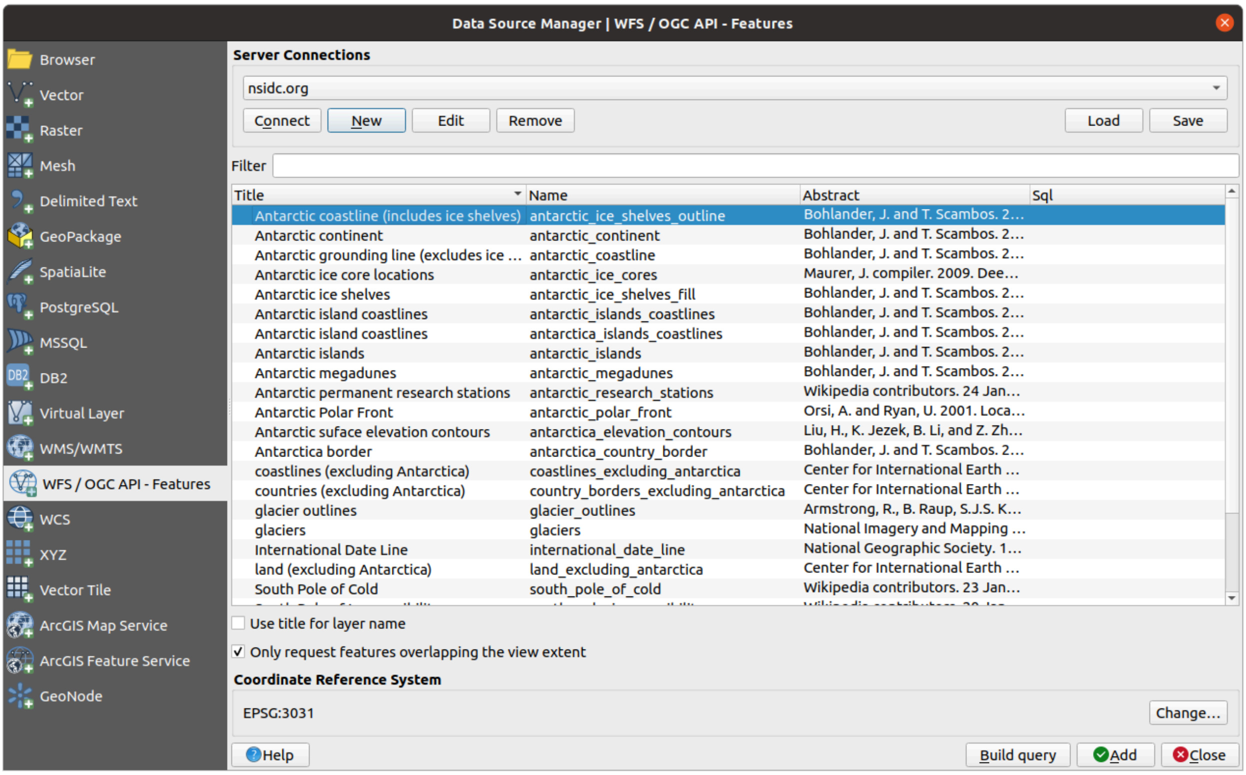

Figure 4. QGIS Data Source Window with OOGCAPI-Features selected.

4.4.2 Accessing Data using Python / Jupyter Notebooks

OGCAPI services can be accessed using Python’s Requests library, this works for both Features & EDR endpoints (Figure 4). The data can then be manipulated into whichever data modelling library you choose for analysis or visualisation.

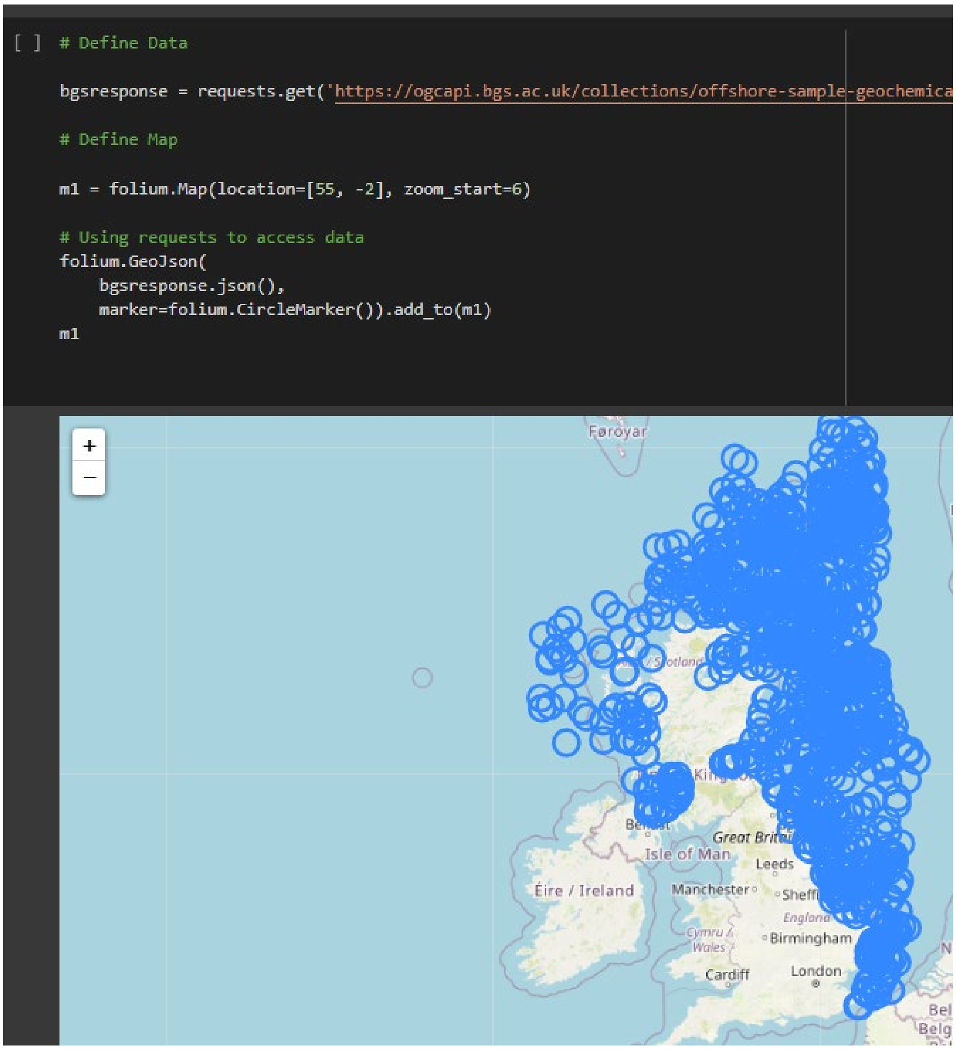

Figure 5. Jupyter Notebook Connection to OGCAPI-Features.

4.5 COMMIT BGS WORK TO SOURCE APPLICATION

We raised a pull request to add our work on pygeoapi into the application source repository on GitHub on 24th August 2022. This pull request was accepted on the 29th October 2022. During the interim period the core pygeoapi developers reviewed our code, made comments, suggestions and requests for amendments to make our code ready to accept.

This means the functionality we added is now available to all users of pygeoapi v0.13+ in the wider geospatial community.

4.6 OGC API – EDR

To implement EDR spatial queries from OGC API – Features + CQL a set of templates are required mapping EDR queries to the CQL equivalents.

- EDR: /area?coords= /radius?coords= /corridor?coords=
- CQL: /items?filter=INTERSECTS(geometry…
- Cube & Trajectory are more challenging but same approach.

BGS also see significant value in supporting the EDR `instances` to allow versioning of datasets available at the same endpoint, however this cannot be achieved through mappings to CQL as `instances` is not present in OGC API – Features.

It is hoped others will build on our initial work and add this functionality to pygeoapi in the future.

5 Resources used – staff time and expertise level, summary effort.

This work required 6 staff at BGS for the main body of work, split between two key tasks.

1. Database updates and & Extract Transform Load (ETL) process to move data
    a. Move data into corporate database that is currently using file-based store.
    b. ETL to copy and sync data to Postgres + PostGIS.
2. Application development of pygeoapi

Staff expertise required:

- 2 Senior Developers – 120 Hours (each)
- 1 Data Architect – 15 Hours
- 1 Data Manager – 80 Hours
- 1 Marine and Info Data Manager – 40 Hours
- 1 Project Manager / DevOps – 80 Hours

Time was spent wholly on technical development with none reserved for technical documentation.

Ongoing maintenance and the addition of new data is anticipated to only require 24 hours per year. This low requirement is partly as we're using a stable "off the shelf" application rather than a bespoke solution.

6 Conclusion and recommendations

Although the project was unable to meet the targeted deliverable of BGS DAC data served using OGC API – EDR, we were able deliver our data using OGC API – Features on a production system. The project also allowed us to gain a better understand of the OGC API suite of standards and ways of working and contribute to free and open-source software (FOSS).

6.1 OGC API – EDR CHALLENGES AND AMBIGUITY

We initially found the standard documentation challenging to understand in the context of our data as the standard is heavily focused on Coverage type data. Coverage data is typically multi-dimensional such as 1D vertical profiles, 3D raster times series or 4D climate and ocean data. Encodings would include GeoTIFF, NetCDF or CoverageJSON

The standards applicability to Features (vector data) was less clear, however, it is apparent the functionality offered for serving Features is excellent, namely its "shortcut" spatial queries vs CQL and ability to specify instances of a dataset. We would expect the standards wider adoption outside coverage type data in the future.

6.2 WORKING WITH FOSS

Two summary learnings from working with and contributing to FOSS software as part of this project are:

- Engage with FOSS software steering committee & developers early.
- Expect things may take as long or longer working with FOSS than working on bespoke solutions from scratch.

If an organisation would like to contribute code to FOSS software, we would suggest it is vital to engage early with the custodians of that software to check alignment of your goals match those of the steering committee and have a clear understanding of deliverables including the process/requirements through which your contributions will be accepted into the main codebase.

FOSS software may already have an extensive code base with multiple dependencies. Gaining an understanding of the system from those who built it is crucial. Gaining this understanding and familiarity with the existing code can take significant effort, compared with starting a new project. Also, the review of an organisation's code contributions may take longer than if working on a bespoke solution in house as the external developers on which you are relying may be working on a voluntary basis with other obligations.

However, we feel there are significant benefits from using and contributing to FOSS solutions in addition to its use meeting the UK government Technology Code of Practice[6] and digital Service Standard[7] guidance.

- Improved transparency, flexibility, and accountability
- Community based collaboration
- Community based security
- Potentially lower implementation and running costs
- "Shared" development costs

[6] https://www.gov.uk/guidance/the-technology-code-of-practice
[7] https://www.gov.uk/service-manual/service-standard

6.3 DELIVERABLES AND OUTPUTS

Primary deliverables from this project are BGS's contribution to pygeoapi software and the delivery of 23 data collections from the BGS DAC using the OGC API – Features standard on a production server.

- pygeoapi Code: https://github.com/geopython/pygeoapi
- BGS Code Contributions: https://github.com/geopython/pygeoapi/pull/964 (126 Commits)
- Production Server: https://ogcapi.bgs.ac.uk/ (Figure 6)

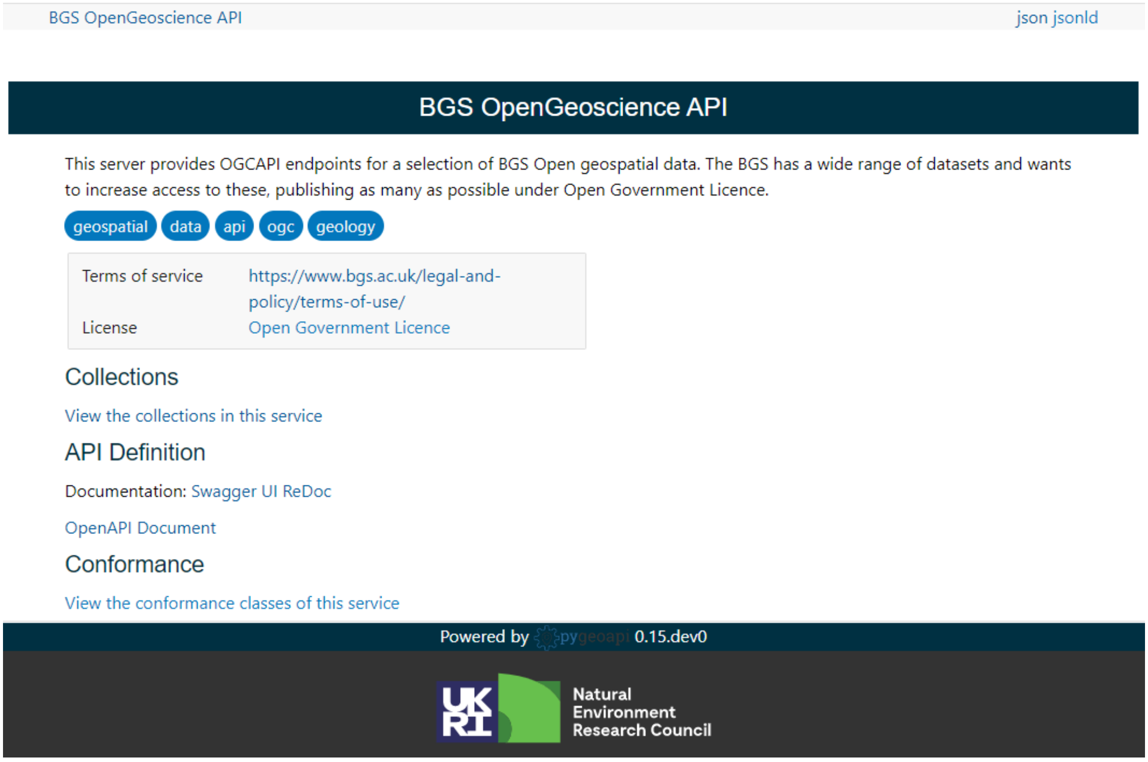

Figure 6. Landing page of the BGS OGC API server at https://ogcapi.bgs.ac.uk/

An incidental outcome of this work is that the new CQL query functionality was automatically deployed as part of an update on a pygeoapi server that BGS configured in Nigeria as part of an overseas project. Thus, other partners have benefited from our contribution to the pygeoapi project as they can now perform richer queries on their data.

6.4 TESTIMONIALS

This MEDIN project allowed us to make significant contribution to FOSS software (pygeoapi) benefiting the wider geospatial community.

We've received the below feedback:

- "Game Changer" – USGS Integrated Modelling and Prediction Division Geo-Intelligence Branch
- "Fantastic work! Thank you for your contributions!!" – Meteorological Service of Canada
- "Thanks, great work here!" – Tom Kralidis, pygeoapi developer
- "Great piece of work, thanks" – Francesco Bartoli, Geobeyond (pygeoapi developer)

It is extremely rewarding to be able to make valued additions to existing software, which is only possible through the FOSS projects.

6.5 OGC API - EDR SUITABILITY FOR MEDIN MARINE COMMUNITY

OGC API Features and EDR both provide potentially very large datasets. This adversely affects performance for visualisation/web delivery (GeoJSON could be GBs in size!).

For large (100+ features) datasets, using OGC API – Tiles (Vector or Map) standard would be more appropriate, this then is serving an image of the data not the data itself (similar to a Web Map Service or Web Map Tile Service).

Users (an application or individual) could then use OGC API – Features or EDR to extract & work on an appropriately sized subset of the data.

> As a point of interest Ordnance Survey (OS) have implemented OGC API – Features to access the OS National Geographic Database and have set **a limit of no more than 100 features per request**.

The Marine Community also have large volumes of Sensor Data. This may be more appropriate to serve using the OGC SensorThingsAPI (STA) standard. However, it would be good to have a mapping of STA to/from EDR to enable data providers to serve data using both standards to provide both options for different types of users.

6.6 SUGGESTED NEXT STEPS

There are a few areas where we would like to see further improvements.

Additional features for pygeoapi:

- OGC API – EDR from Postgres data provider
  - Finalising the work, we started on this project.
  - Ideally offering optional support for `instances` queries.
- Additional coordinate reference system (CRS) support
  - Currently only EPSG: 4326 is supported by pygeoapi.
- Offer additional data encodings (FlatGeoBuf, GeoPackage, AGS).
- Further Documentation and Examples on use of the software and query options.

Improvements to OGC API – EDR standard documentation:

- Highlight the applicability of the standard to vector data.
- Add further examples for implementers who are working with exclusively vector data.

Standards development:

- Work on agreed mapping between OGC SensorThingsAPI and OGC API – EDR.

Appendix 1

List of BGS DAC datasets added to https://ogcapi.bgs.ac.uk/

collections/id	collections/title	collections/description
scanned-maps-1m	BGS Scanned Maps (1:1M)	This layer includes the BGS 1:1M published maps; Seabed Sediments; Bedrock; Quaternary, North and South sheets. Click on link in the view map attribute to open the map in a viewer. Note the publication dates (latest mapping is available through the BGS digital maps).
scanned-maps-500k	BGS Scanned Maps (1:500k)	This layer includes BGS 1:500k published maps. Click on the view map link to open the map in a viewer. Note the publication dates (latest mapping is available through the BGS digital maps).
scanned-maps-250k	BGS Scanned Maps (1:250k)	This layer includes the BGS 1:250k published maps. Maps in this series show three sorts of geological information: solid 'bedrock' geology, (S), Quaternary or 'drift' geology (Q), or sea-bed sediments (Ss). These are usually presented as separate sheets, although sea-bed sediments and Quaternary geology, or sea-bed sediments and solid geology may be shown on the same sheet. Quaternary geology maps are for offshore areas only. Sheets were published between 1977 and 2000 with a few special area sheets up to 2009. Sheets were issued on a regular grid based on the UTM of two degrees longitude by one degree latitude. Note the publication dates (latest mapping is available through the BGS digital maps). Map Index - https://www.bgs.ac.uk/data/maps/docs/OFF250k_coverage.pdf. List of Maps - https://www.bgs.ac.uk/data/maps/maps.cfc?method=listResults&mapName=&series=OFF250k&scale=&pageSize=174.
offshore-survey-overview	Offshore Survey Overview	This layer shows the location and basic information for coastal and marine surveys. It includes information about the survey, including the types of equipment deployed during the survey. For some surveys, a zip file of additional data can be downloaded using the URL link provided where available. For more information, please contact Marine Enquiries (offshoredata@bgs.ac.uk).
offshore-factor-map-bsl	BGS Geological Factor Map Offshore - Bedrock Summary Lithologies	A series of maps describing geological factors relevant to offshore seabed activities. Produced in collaboration with The Crown Estate in 2014. The Bedrock Summary Lithologies dataset is a digital geological map across the bulk of the UK Continental Shelf (UKCS), for areas up to a water depth of 200m, which groups the bedrock lithologies (rock types) into classes based on similar engineering geology characteristics. The map is derived from the 1:250,000 scale digital bedrock map of the UKCS, called DiGRock250k, which is available separately from the BGS. The map was produced in 2014 in collaboration with The Crown Estate as part of a project to assess seabed development opportunities across the UKCS. This map has been released for viewing on the Offshore GeoIndex alongside a series of other offshore geological maps from the BGS.
offshore-factor-map-qdsl	BGS Geological Factor Map Offshore - Quaternary Deposits	A series of maps describing geological factors relevant to offshore seabed activities. Produced in collaboration with The Crown Estate in 2014. The Quaternary Deposits Summary Lithologies dataset is an offshore digital geological map across the bulk of the UK Continental Shelf (UKCS), for areas up to a water depth of 200 m, which groups the deposits into classes based on similar engineering geology characteristics. The map is derived from (unpublished) BGS 1:1,000,000 scale Quaternary digital geological mapping. The map was produced in 2014 in collaboration with The Crown Estate as part of a project to assess seabed development opportunities across the UKCS. This map has been released for viewing on the Offshore GeoIndex alongside a series of other offshore geological maps from the BGS.

	Summary Lithologies	
offshore-factor-map-qdt	BGS Geological Factor Map Offshore - Quaternary Deposits Thickness	A series of maps describing geological factors relevant to offshore seabed activities. Produced in collaboration with The Crown Estate in 2014. The Quaternary Deposits Thickness dataset is a digital geological map across the bulk of the UK Continental Shelf (UKCS), for areas up to a water depth of 200m, which shows the thickness of the deposits over bedrock in three categories:<5m, 5-50m, and >50m Quaternary cover. These depth bands were picked because they represent the horizons that have impact on offshore infrastructure deployment. The map is derived from (unpublished) BGS 1:1,000,000 scale Quaternary digital geological mapping. The map was produced in 2014 in collaboration with The Crown Estate as part of a project to assess seabed development opportunities across the UKCS. This map has been released for viewing on the Offshore GeoIndex alongside a series of other offshore geological maps from the BGS.
offshore-core-sample-data	Core Sample Analysis Data - NSTA Wells	Core sample analysis data produced from sampling activities of offshore core held on behalf of the North Sea Transition Authority (NSTA) at the National Geological Repository (NGR). Data is provided as received.
offshore-sample-activity-data	Offshore Sample Data - Activity & Scan	This layer shows the location and basic information for offshore sampling activities. It contains information about the activities which are conducted at a location resulting in the collection of data and/or physical material. Links to scanned images of sample description sheets, core and borehole logs are provided (where available) for openly available sampling activities where terms of use are known. Sampling activities include boreholes, shallow cores, seabed grabs and dredges. There may be several activities carried out at a single location. In addition to the ACTIVITY_ID, samples are uniquely named using a degree square, a number within the square, an equipment code and equipment attempt number. An example would be +54-003/1201/VE/2 – this is the 2nd Vibrocore at survey station 1201 within degree square 54° to 55°N and 2° to 3°W. Related data in Offshore Geology Data, Offshore Geotechnical Data, Offshore Geochemical Data and Offshore Seabed Sediment Collections.
offshore-sample-geochemical-data	Offshore Geochemical Data	This layer provides geochemical analysis associated with offshore sampling activities. It contains analysis of 38 elements and should be used as a baseline for chemical element concentrations in seabed sediments, against which samples collected in the future may be assessed. Related data in Offshore Sample Data - Activity & Scan collection.
offshore-sample-geological-data	Offshore Geology Data	This layer provides geological descriptions associated with offshore sampling activities. It contains a variety of geoscientific observations; these include rock/sediment classification, grain size, sorting, sphericity, roundness, hardness, plasticity, presence of flora or fauna, colour, chronostratigraphy and lithostratigraphy. Note that this layer contains data at depth. Related data in Offshore Sample Data - Activity & Scan collection.
offshore-sample-geotechnical-data	Offshore Geotechnical Data	This layer provides geotechnical readings associated with offshore sampling activities. It contains a variety of types of geotechnical measurements; these include shear and compressive strength. Expert advice may be required in the use of these data. Note that this layer contains data at depth. Related data in Offshore Sample Data - Activity & Scan collection.
offshore-seabed-sediment-data	Offshore Seabed Sediment Data	This layer provides particle size analysis associated with offshore sampling activities. It contains a variety of types of particle size analysis; these include folk analysis, gravel, sand and mud percentages, phi and half-phi sand analysis and carbonate analysis based on gravel, sand and mud fractions. Note these data are primarily from the seabed but contain some data at depth. BGS data input methodologies used in the past between northern and southern parts of BGS vary. The underlying PHI data values are sound except where human error may have occurred. Where the sand PHI weight analysed was a split/fraction of the total sand component of the sample in the northern and southern parts

		of BGS adopted differing data recording methods. The BGS northern part of BGS generally recorded the sand PHI weight for each PHI interval for the actual volume of sample analysed. The BGS southern part of BGS generally took the sand PHI weight for each PHI interval then calculated the percentage of each PHI sand interval and used these values to back calculate the PHI sand weight representative of the total sand which was then recorded in the database. Related data in Offshore Sample Data - Activity & Scan collection.
offshore-oil-gas-site-surveys	Offshore Oil & Gas Industry Site Surveys	This layer shows the geographic location of oil and gas industry site surveys. The metadata for these surveys were collated via the BGS MEDIN Data Archive Centre (DAC). BGS do not hold the data. For further information contact the Custodian of the data. BGS operates as the Data Archive Centre (DAC) for seabed and sub-seabed geology and geophysics for MEDIN (Marine Environment Data and Information Network).
offshorebackscatterareas	Offshore Backscatter Polygons & Data	This layer shows the location and basic information for bathymetric surveys containing backscatter data. A zip file of the backscatter image files (e.g., geotiffs) for the survey can be downloaded using the URL link provided. Note that there can be more than one polygon per survey, and these will link to the same zip file for the entire survey. For access to the data underlying the images please contact Marine Enquiries (offshoredata@bgs.ac.uk). The majority of the data were collected and processed for the Maritime and Coastguard Agency (MCA) under the Civil Hydrography Programme. If further processing is required, BGS can provide a quote. To download the related bathymetry data, go to the Admiralty Marine Data Portal - https://data.admiralty.co.uk/portal/apps/sites/#/marine-data-portal.
offshore-geophysical-survey-lines	Offshore Geophysical Lines	Contains information and data for offshore geophysical survey lines and start/end of line co-ordinates. Geophysical surveys include shallow seismic reflection (e.g., airgun, boomer, pinger, sparker and water gun) and sonar (e.g., echo sounder, sidescan sonar and transit sonar). There may be several equipment's deployed on a single survey line. In addition to SURVEY_LINE_ID, survey lines are uniquely named as survey and line identifier (name or number). An example would be 1985/6 16 – this is line 16 of survey 1985/6. The Seismic lines includes sub seabed imaging which provides information about structures below the seabed. The Sonar lines includes seabed imaging which provides information about the roughness of the seabed or simple bathymetric (depth) data. Links to scanned images of geophysical records are provided (where available). The Shot Point layer contains details of all shot points for a survey line.
offshore-geophysical-survey-shot-points	Offshore Geophysical Shot Points	This layer shows the location of offshore geophysical survey line shot points. It contains details of all shot points for a survey line.
offshore-sea-areas	Offshore Strategic Environmental Assessment (SEA) Areas	This layer shows the location of the Strategic Environmental Assessment (SEA) areas. Select SEA_DOCUMENTS_URL to open the SEA Data Portal with all data for that SEA area selected. Free and open access to available data and reports which have been produced through the Department for Business, Energy & Industrial Strategy (BEIS) SEA process. These data are managed by BGS on behalf of BEIS.
offshore-sea-data-bbox	Offshore Strategic Environmental Assessment (SEA) Data Bounding Boxes	This layer shows the bounding boxes of SEA datasets and reports. The data/reports can be downloaded using the URL link provided. The data/reports can also be searched and downloaded via the SEA Data Portal.

offshore-sea-doc-event-area	Offshore Strategic Environmental Assessment (SEA) Polygon Data	This layer shows the location of Strategic Environmental Assessment (SEA) Multibeam bathymetry and backscatter, sidescan sonar and pockmark data. The data/reports can be downloaded using the URL link provided. The data/reports can also be searched and downloaded via the SEA Data Portal. Free and open access to available data and reports which have been produced through the Department for Business, Energy & Industrial Strategy (BEIS) SEA process. These data are managed by BGS on behalf of BEIS.
offshore-sea-doc-event-line	Offshore Strategic Environmental Assessment (SEA) Line Data	This layer shows the location of Strategic Environmental Assessment (SEA) seabed video track data. The data can be downloaded using the URL link provided. The data can also be searched and downloaded via the SEA Data Portal. Free and open access to available data and reports which have been produced through the Department for Business, Energy & Industrial Strategy (BEIS) SEA process. These data are managed by BGS on behalf of BEIS.
offshore-sea-doc-event-point	Offshore Strategic Environmental Assessment (SEA) Point Data	This layer shows the location of Strategic Environmental Assessment (SEA) seabed photo and sample point data (including geological, particle size analysis, biological and chemical data). The data/reports can be downloaded using the URL link provided. The data/reports can also be searched and downloaded via the SEA Data Portal. Free and open access to available data and reports which have been produced through the Department for Business, Energy & Industrial Strategy (BEIS) SEA process. These data are managed by BGS on behalf of BEIS.
offshore-hydrocarbon-wells	Offshore Hydrocarbon Wells	This layer shows hydrocarbon wells. The United Kingdom Continental Shelf (UKCS) offshore hydrocarbon well borehole materials collection contains material from approximately 9000 wells, including over 300km of drillcore and 4.5 million samples of cuttings. During 2011–12, the collection was transferred from Gilmerton to Keyworth. Transferred core has been photographed and links to the photos are provided where available. You can also use a form to search the offshore hydrocarbon wells database. Further information for UKCS wells, seismic surveys, production infrastructure and licences, including a searchable form and a map interface are publicly available from the UK National Data Repository (NDR) and the North Sea Transition Authority (NSTA).

Table 1 List of BGS DAC datasets added to https://ogcapi.bgs.ac.uk/ and made available using OGCAPI-Features

Glossary

OGC Open Geospatial Consortium, an international voluntary consensus standards organization for geospatial content and location-based services, sensor web and Internet of Things, GIS data processing and data sharing.

API An application programming interface is a way for two or more computer programs to communicate with each other.

OGC API – Features OGC API - Features is a multi-part standard that offers the capability to create, modify, and query spatial data on the Web and specifies requirements and recommendations for APIs that want to follow a standard way of sharing feature data.

OGC API – Tiles The OGC API - Tiles standard defines building blocks for creating Web APIs that support the retrieval of geospatial information as tiles. Different forms of geospatial information are supported, such as tiles of vector features (“vector tiles”), coverages, maps (or imagery) and other types of geospatial information. An Environmental Data Retrieval (EDR) API provides a family of lightweight interfaces to access Environmental Data resources.

OGC API – Environmental Data Retrieval An Environmental Data Retrieval (EDR) API provides a family of lightweight interfaces to access Environmental Data resources. This specification addresses two fundamental operations: discovery and query.

BGS The British Geological Survey, global geoscience organisation, focused on public-good science for government and research to understand earth and environmental processes.

DAC Data Archive Centres.

NGDC The National Geoscience Data Centre (NGDC) collects and preserves geoscientific data and information, making them available for the long-term to a wide range of users and communities. The NGDC is recognised as the NERC Environmental Data Centre for geoscience data.

BGS DAC The geology, geophysics and backscatter DAC is operated by the British Geological Survey (BGS) and stores seabed and sub-seabed geological and geophysical data covering the UK Continental Shelf (UKCS) area.

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