ARKTALAS HOAVVA PROJECT

DELIVERABLE D-60: ARKTALAS VISUALISATION AND ANALYSIS SYSTEM (AVS) USER GUIDE

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This Deliverable D-60: AVS user guide is associated with Task 2b: Implementation of Analyses and Visualization System. It follows the structure and outline indicated in the Statement of Work (SoW) and the Arktalas Hoavva technical project proposal.

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1 OVERVIEW

The goal of the Arktalas Hoavva Analysis and Visualisation System (AVS) is to display data representations at full resolution on an interactive map for the data sets stored in the Arktalas-Data Archive System (ADAS).

Users only need an Internet access and a recent web browser to visit the AVS. It is available at https://arktalas.oceandatalab.com.

The AVS is able to display a wide variety of data and supports multiple rendering methods in order to provide meaningful and intuitive visualisation for in-situ measurements, satellite acquisitions and results produced by numerical models or analyses.
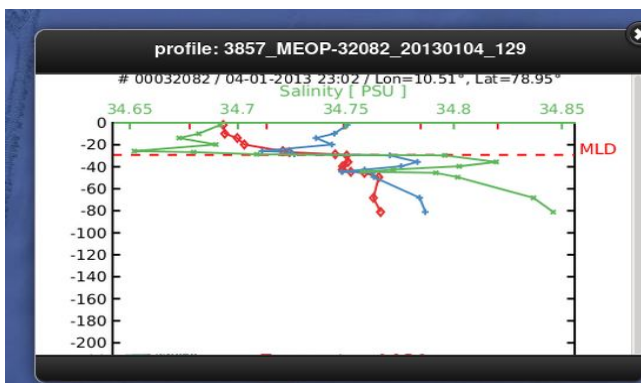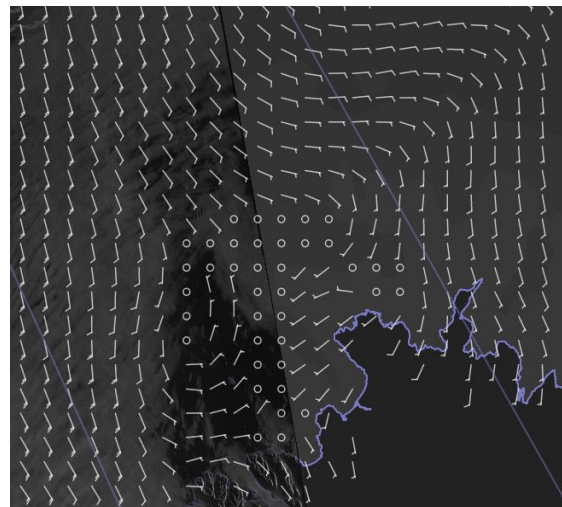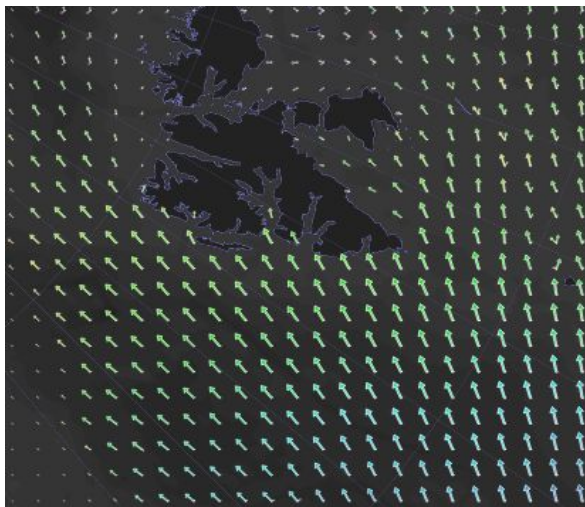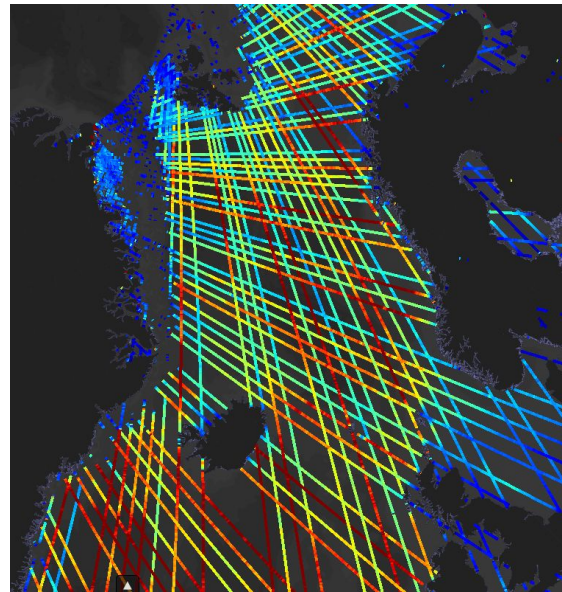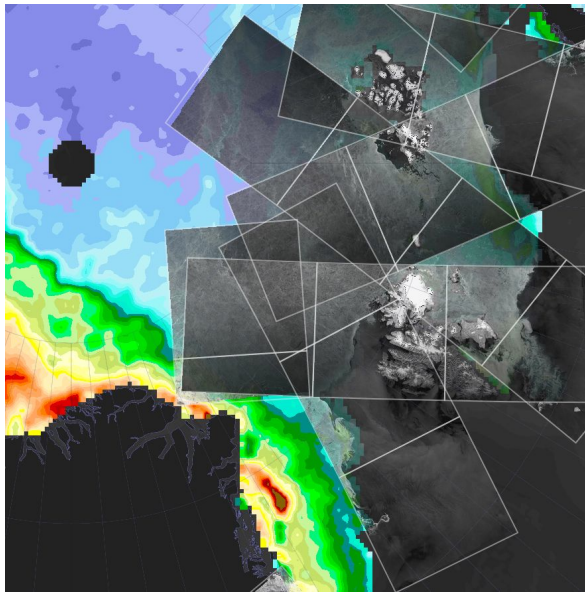
2   WEB USER INTERFACE

The Web user interface is composed of four main areas:
1. the products list is located on the left side of the screen
2. the header bar contains links to websites related to the project and buttons that give access to advanced functionalities
3. the timeline sits at the bottom of the screen and provides information regarding data availability
4. the central area contains the interactive map
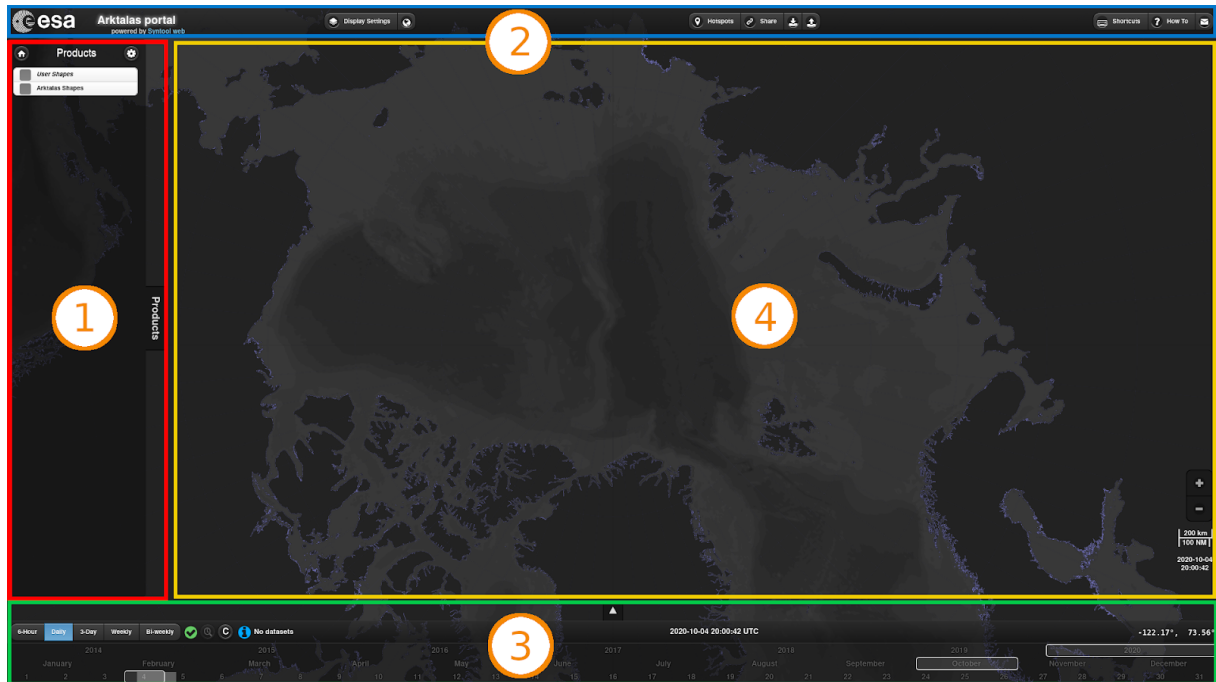
2.1   Data selection

The AVS displays data on the interactive map if they match three main criteria:

- they must belong to a product selected by the user.

- their time coverage must intersect either A) the datetime or B) the time window selected in the timeline. The configuration of the portal states the rule to apply on a per-product basis : as a rule of thumb, global products (model output, analysis results) are configured to follow rule A) whereas local products (satellite snapshots, in-situ measurements) follow rule B).

- their spatial coverage must intersect the viewport of the interactive map and their web representation must be available for the current map zoom level.

2.1.1 Products selection

The menu on the left side of the screen lists all the products registered in the AVS.

By checking the box in front of a product, the user tells the AVS that the data belonging to this product should be displayed on the map.

Several products can be selected at once to compare them visually or to exploit their synergy.

Users can obtain a short description of each product available in the AVS very quickly by putting the mouse cursor over an item in the list: a tooltip will appear and provide some additional information about the product.

Tooltips are not suited for handling large amounts of information, so the AVS also provides a way to display more details about the products: clicking on the information button will display a popup window containing a more extensive description of the products, including images and clickable links.

2.1.2 Spatial selection

The spatial criteria for searching data is based on the viewport of the map (i.e. the area visible on the screen) : panning the map with a drag'n'drop or changing its zoom level with the mouse wheel will update the spatial filter that the AVS uses when searching data to display.

Some products are only available for a specific range of resolutions and will not be displayed on the map if the map zoom level does not belong to this range. The AVS notifies users about this situation by adding a magnifier symbol in front of each selected product that is not compatible with the current zoom level.

In addition to the magnifier symbol, a red arrow shows if the product is available only at a lower (red arrow pointing up) or a higher resolution (red arrow pointing down).

Clicking on the magnifier symbol will change the zoom level of the map to reach the closest resolution that is compatible with the associated product.

2.1.3 Temporal selection

The timeline component defines the time constraints used when the AVS searches data to display. These constraints are based on a time window defined with a central datetime and a duration that spans around this datetime.

The central date is selected by choosing a year, a month and a day in the calendar control. This control also provides information regarding the availability of data that match the products and the spatial filters: years, months and days rendered in white contain data that match the other search criteria, otherwise they are colored in grey.
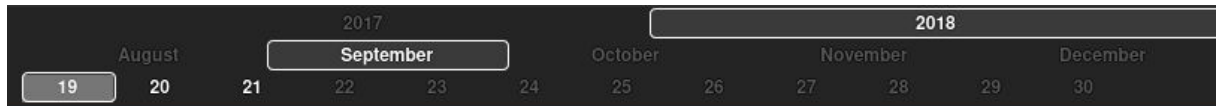

Selecting the date is enough in most cases because the AVS provides the button to automatically shift the time to the closest data available for the current map viewport and selection of products.

Users can also change the time by opening the extended timeline with the button and dragging the extended timeline left or right. This view of the timeline also shows the time coverage of each data visible on the map, either as a line or a dot depending on whether the time coverage lasts more or less than ten minutes.
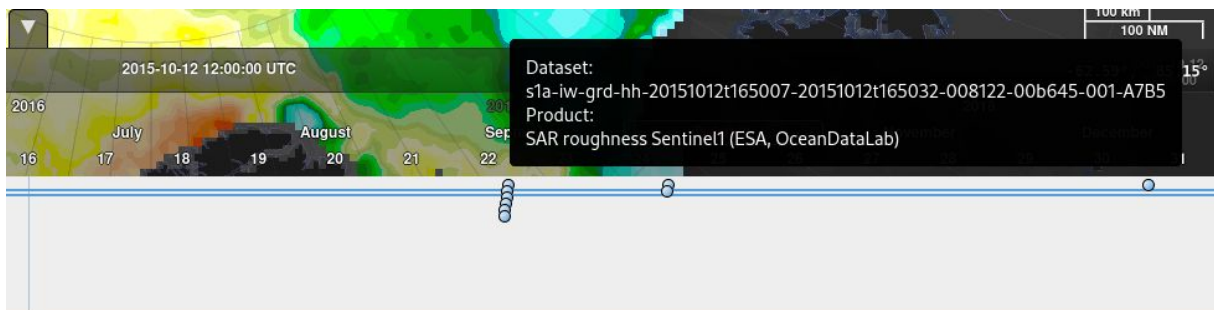
Note that you can scroll on the calendar control with the mouse wheel to quickly browse through time.

The timeline control has a list of toggle buttons for selecting the span of the time window: the selected duration is distributed evenly around the central datetime.
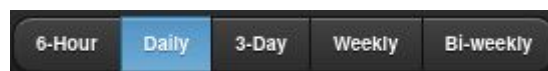

The configuration of the portal states for each product if their time coverage must intersect current datetime or if being in the time frame is enough to appear on the map.

2.2 Rendering configuration

The AVS loads pre-rendered images in order to achieve good performance and offer a good user experience when browsing large amounts of data. As a consequence, most rendering parameters, such as the extrema or the colormap, can not be modified by users.

The Display Settings menu, which is accessible from the header bar, shows the settings that the Arktalas team has chosen for each product and provides controls for changing the transparency and order for the products selected by the user.
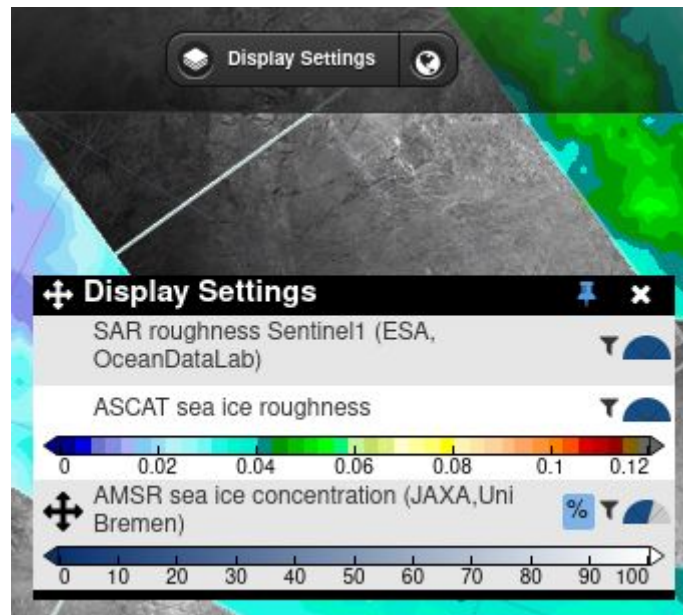
It has been designed to be as compact as possible so that it may also be used as a legend when taking screenshots of the AVS.

Products are stacked on the map in the same order as they appear in the Display Settings menu: the product appearing first in the menu is the one displayed on top of all the others on the map. This order can be changed using drag'n'drop to move products in the Display Settings menu and therefore change the order in which they are displayed on the map.

The transparency of each product can be modified by using the mouse wheel when the mouse cursor is over the ◖ gauge symbol. Alternatively you can achieve the same result by pressing the left button over the gauge and moving the mouse up or down (without releasing the left button).

The Display Settings menu also allows users to show only data whose identifier match a pattern: clicking on the ▼ symbol opens a text field where the pattern can be provided. Please note that the filter is not applied until the user validates the pattern by pressing the Enter key.

2.3 Collocation

The AVS provides a tool to quickly identify when several products of interest are available at the same time for a given area, which is quite useful to find synergies and discover new case studies.

This tool can be activated by clicking on the collocation button in the timeline. When the tool is active the timeline shows years, months and dates in red if the selected products are all available at the same time. The timeline will paint years and months in yellow instead of red if they have data for all selected products but not at the same dates .

2.4 Map annotations

The AVS features a tool that allows users to add their own annotations on the map.

In order to activate the map annotations tool, users have to select the "User Shapes" product in the list on the left side of the screen.

A new menu will then appear on the top right corner of the map area and offer buttons to create different types of annotations.


After selecting the annotation type, the user can start placing vertices by clicking on the map and complete the drawing by a double click.

The newly created annotation will be selected automatically and a contextual menu will appear on the right side of the screen to show the properties of the annotation.

These properties can be edited to change the time coverage of the annotation, add a label, configure the rendering, etc…

Annotations can be exported in JSON format to share them with other users.
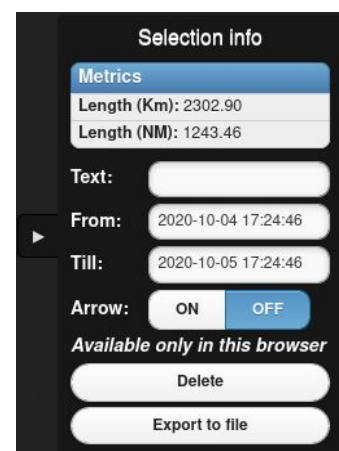
It has to be noted that annotations drawn by users are stored on their computer and are therefore not visible by other people that visit the AVS. It is possible to define annotations directly in the configuration of the portal so that they will be available for all users but that functionality is only available to the Arktalas team.

2.5   Sharing information

The AVS can be used to promote the research performed in the Arktalas case studies and serve as a graphical support to communicate with the scientific community.

The web portal offers several mechanisms to achieve this goal: short links, hotspots and import/export in JSON format.
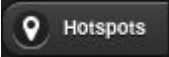
2.5.1   Short links

The AVS features a mechanism to save its selected date, time, viewport and products in the form of a simple web link that can be embedded in an email, an article or a message in social media. Sharing these links allows other users to open the AVS in the exact same state and can therefore be used as an interactive illustration for an article or as a graphical support during discussions with other members of the scientific community.
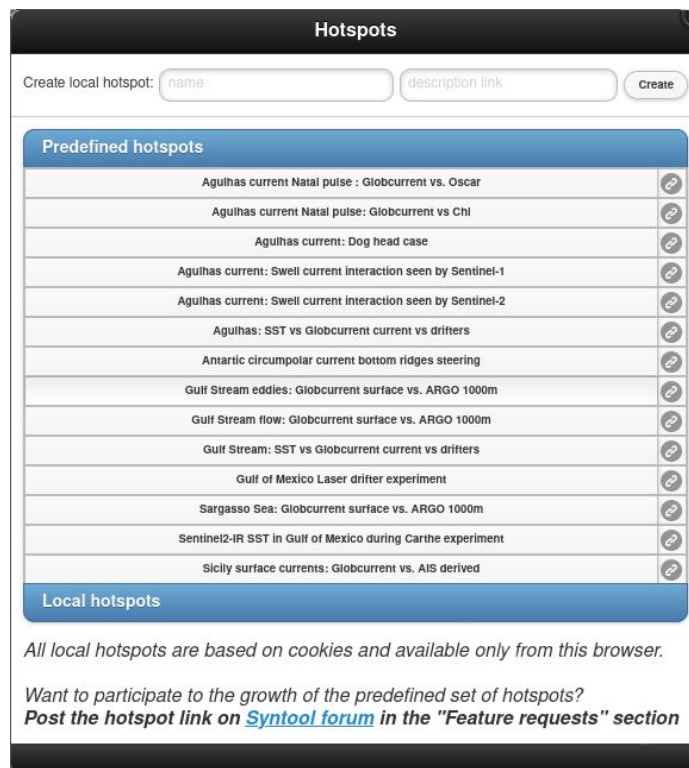
Clicking on the [Share] button will generate a short link and display it in a popup window where the user can copy it easily.

2.5.2   Embedded links for documented cases

The AVS also provides a way to create local (but shareable) bookmarks so that the short links appear with a descriptive title directly in the application and may be associated with an external URL.

Such bookmarks, also known as "hotspots", can also be configured directly in the portal configuration to share them with all users and can therefore be used to give a quick access to cases of interest for the Arktalas studies, along with a link to the related research paper or an article describing the case study on the main Arktalas website.

These hotspots are available in a popup menu which appears by clicking on the [Hotspots] button.

2.5.3 Importing/exporting user annotations and hotspots

Users can export their hotspots and annotations as JSON files in order to share them with other people, to use them in analysis scripts, to transfer them on another computer or simply to keep a backup.

Clicking on the ![button] button will export all hotspots and annotations and prompt the user for a file to save the result.

Hotspots and annotations, whether they have been exported individually or globally with the ![button] button, can be imported in the AVS by clicking on the ![button] button in the header bar and providing the path of the JSON file to load when prompted.

Holding the Shift key changes the appearance of the import/export buttons to this: ![buttons].

In this mode, instead of using a file to load/save annotations and hotspots, the import and export mechanisms use the clipboard as a buffer, which is quite useful to quickly share annotations and hotspots by email.

3 WEB SERVICES

The AVS relies on three endpoints of the webservice to get the availability of data at the product level (/coverage), information about individual granules (/datasets) and additional details about a specific granule (/getGranuleInfo).

3.1 /coverage

Given a list of product identifiers and a geographical area, this service returns the daily availability of each product within the specified area, encoded as a binary blob.

Input parameters

Parameter	Required	Format	Example
products	yes	string,string,...	3857_MEOP,3857_SMOS_L2
extent	no	float,float,float,float	18706892.551797,-21231148.973535,18706892.551797,21231148.973535
patterns	no	string,string,...	,6901687_43,
endianess	no	string	big

- ***products***: Only consider granules from the listed products. The supplied parameter is a comma-separated list of product identifiers.
- ***extent***: Limit availability computation to granules that intersect the supplied area. The supplied parameter is a comma-separated list of four float values. These values are the coordinates of the area bounding box expressed in the same projection as the Syntool portal (EPSG:3413 for the Arktalas portal). The order of the coordinates is West,South,East,North.
- ***patterns***: Ignore granules whose identifier does not match the supplied pattern. The supplied parameter is a comma-separated list of patterns. There must be as many patterns as there are identifiers in the products parameter, listed in the same order. For example with an "A,B,C,D" products value, if only C and D must be filtered using patterns, then the patterns parameter must be ",,patternC,patternD".
- ***endianess***: The webservice will encode the result in little-endian order by default, but can use big-endian if this parameter has the value "big"

Output

The webservice returns the coverage of each product encoded using a list of 32 bits unsigned integers built using the following algorithm:

For each product:

- one integer whose value identifies the product
- for each year when data is available
  - one integer whose value is the year of availability
  - twelve integers, one for each month, whose individual bits represent the availability of data for a given day of the month
- one integer used as a separator (0xFFFFFFFF)

3.2   /datasets

This service returns the metadata of all the registered EO data that match a filter composed of a product identifier, a geographical area and a time range.

Input parameters

Parameter	Required	Format	Example
callback	no	string	processGranule
minDate	yes	timestamp	1512141988
maxDate	yes	timestamp	1512141990
products	no	string,string,...	3857_MEOP,3857_SMOS_L2
extent	no	float,float,float,float	18706892.551797,-21231148.973535,18706892.551797,21231148.973535
patterns	no	string,string,...	,6901687_43,
dates_only	no	flag	anything

- ***callback***: Callback will be used as a wrapper for the result. For example if callback = "myCallback", the webservice will return "myCallback("+str(result)+")"
- ***minDate***: Unix timestamp for the start of the time frame constraint.
- ***maxDate***: Unix timestamp for the end of the time frame constraint.
- ***products***: Only consider granules from the listed products. The supplied parameter is a comma-separated list of product identifiers.
- ***extent***: Limit availability computation to granules that intersect the supplied area. The supplied parameter is a comma-separated list of four float values. These values are the coordinates of the area bounding box expressed in the same projection as the Syntool portal (EPSG:3413 for the Arktalas portal). The order of the coordinates is West,South,East,North.
- ***patterns***: Ignore granules whose identifier does not match the supplied pattern. The supplied parameter is a comma-separated list of patterns. There must be as many patterns as there are identifiers in the products parameter, listed in the same order. For example with an "A,B,C,D" products value, if only C and D must be filtered using patterns, then the patterns parameter must be ",,patternC,patternD".
- ***dates_only***: If this parameter is provided the web service will only return time-related information for database entries that match the criteria instead of returning the full details.

Output

The webservice returns a list of dictionaries (wrapped in a callback if provided) describing the granules that match the search criteria.

The dictionaries describing granules contain a set of entries:

- *polygon*: shape of the granule as WKT polygon. Coordinates must be expressed in the same projection as the Syntool portal (EPSG:3413 for Arktalas). For granules with global coverage, POINT(0 0) is used instead.
- *mapMaxZoom*: zoom level above which the data representation is not available anymore.
- *uri*: path of the data representation files (root of the tiles pyramid, geojson file or full resolution image) relative to the URI of the data server.
- *productId*: identifier of the product the granule belongs to (should be one of the identifiers passed in the products input parameter).
- *datasetId*: identifier of the granule.
- *title*: label describing the granule.
- *mapBounds*: dictionary describing the bounding box of the granule, with coordinates expressed in the same projection as the Syntool portal (EPSG:3413 for Arktalas) using the following format: {"west": WEST, "east": EAST, "north": NORTH, "south": SOUTH}.
- *resolutions*: when applicable, array of the resolutions for which there is a data representation. May also contain some additional information for specific data representations (mask for tiled rasterized altimeter data).
- *start*: start of the time coverage of the granule, expressed as a string with the "YYYY-MM-DDThh:mm:ss" format.
- *end*: end of the time coverage of the granule, expressed as a string with the "YYYY-MM-DDThh:mm:ss" format.
- *type*: deprecated
- *mapMinZoom*: deprecated
- *point*: deprecated

3.3 /getGranuleInfo

This service provides additional information related to a specific entry in the database (i.e. a granule). Only applicable if such information exists.

Input parameters

Parameter	Required	Format	Example
product_id	yes	string	3857_MEOP
dataset_name	yes	string	48390_201514_200

- *product_id*: Identifier of the product which contains the granule of interest.
- *dataset_name*: Identifier of the granule.

Output

The webservice returns a list of features/extra information attached to the granule serialized in JSON format. These features are described using dictionaries with a mandatory "global" key. The "global" value is specific to Syntool and provides information about how the feature must be displayed. Extra keys may be added to provide more details about the granule or the feature.

The "images" key can be used to define a dictionary of pictures associated with the granule. Syntool will display these pictures directly in the application, in a dialog box. The syntax for the "images" dictionary entries is:

"Label": DescriptionURLAuto_display"

where:
- Label is the text displayed in the contextual menu
- Description is the tooltip shown when the user leaves the mouse cursor over the label for a few seconds
- URL is the URL of the image
- Auto_display is either 1 or 0. A 1 value tells Syntool to display the image immediately when the granule is selected, otherwise the user has to click on the link in the contextual menu. Only one image can be defined with Auto_display = 1.

The "links" key can be used to define a dictionary of remote resources associated with the granule. Syntool will display links to these resources in the contextual menu. The syntax for the "links" dictionary entries is:

"Label": Description$URL"

where:
- Label is the text displayed in the contextual menu
- Description is the tooltip shown when the user leaves the mouse cursor over the label for a few seconds
- URL is the URL of the remote resource

4 INSTALLATION PROCEDURE

This procedure has been written assuming that there are two machines running an Ubuntu 18.04 operating system: one for processing data (IP address 111.222.333.444) and one for hosting the Syntool webservice and its database (IP address 555.666.777.888).

A system user named "syntool" must exist on the webservice host.

The instructions below contain two passwords (REDACTED1 and REDACTED2) for the MySQL database, one for a read-only account (syntool_webservice) and one for a read-write account (syntool_processor).

It has to be noted that the Syntool processing tools have been written for Python 2.7, whereas the webservice supports Python2.7 and Python3.7+.

4.1 Processing tools

```
# System dependencies
apt install python-tk python-pip gdal-bin libgdal-dev unzip wget libeccodes-dev
apt install mariadb-client

# Workaround for HDF4 library
ln -s libdfalt.so /usr/lib/libdf.so
ln -s libmfhdfalt.so /usr/lib/libmfhdf.so

# Basic Python packages
pip install cython
pip install numpy
pip install pyproj

# GDAL Python package installation
gdal_version="$(gdal-config --version)"
workspace="$(mktemp -d)"
cd "${workspace}"
pip download "gdal<=${gdal_version}"
find . -name "*.tar.gz" -exec tar xzf {} \;
cd "$(find . -mindepth 1 -maxdepth 1 -type d)"
python setup.py build_ext --include-dirs=/usr/include/gdal/
python setup.py install
cd
rm -rf "${workspace}"
```

```
# Cerbere installation
pip install https://ftp.odl.bzh/odl/syntool/libs/cerform-0.1.0.tar.gz
pip install https://ftp.odl.bzh/odl/syntool/libs/cerinterp-0.1.0.tar.gz
pip install https://ftp.odl.bzh/odl/syntool/libs/ceraux-0.1.0.tar.gz
pip install https://ftp.odl.bzh/odl/syntool/libs/cerbere-0.1.738.tar.gz
```

```
# Syntool processing tools installation
pip install https://ftp.odl.bzh/odl/syntool/libs/sar4ocean-0.0.71.tar.gz
pip install
"https://ftp.odl.bzh/odl/arktalas/syntool/syntool_converter-0.1.769.tar.gz#egg=syntool_converter[sar,sentinel2,modis]"
pip install https://ftp.odl.bzh/odl/arktalas/syntool/syntool_ingestor-0.1.324.tar.gz
pip install https://ftp.odl.bzh/odl/arktalas/syntool/syntool_exporter-0.1.17.tar.gz
```

```
mkdir -p /etc/syntool
```

 # Sample configuration files
```
wget https://ftp.odl.bzh/odl/syntool/syntool_config_samples.tar.gz \
 -O /tmp/syntool_config_samples.tar.gz
tar xzf /tmp/syntool_config_samples.tar.gz -C /etc/syntool/
```

 # Auxiliary files
```
wget https://ftp.odl.bzh/odl/syntool/syntool_aux_samples.tar.gz \
 -O /tmp/syntool_aux_samples.tar.gz
tar xzf /tmp/syntool_aux_samples.tar.gz -C /etc/syntool/
```

4.2   Web service

 # System dependencies
```
apt install python-pip
apt install libmysqlclient-dev
apt install nginx wget
```

 # Install and configure MySQL server
```
apt install mysql-server
mysql_secure_installation
sed -i 's/^bind-address\s*=.*/bind-address=555.666.777.888/' \
     /etc/mysql/mysql.conf.d/mysqld.cnf
systemctl restart mysql
systemctl enable mysql
```

 # Initialize MySQL database
```
mysql -e 'CREATE DATABASE syntool'
mysql -e 'ALTER DATABASE syntool CHARACTER SET latin1 COLLATE latin1_general_ci;'
mysql -e "GRANT SELECT, LOCK TABLES, SHOW VIEW, EVENT, TRIGGER ON syntool.* \
         TO 'syntool_webservice'@'localhost' IDENTIFIED BY 'REDACTED1';"
mysql -e "GRANT ALL PRIVILEGES ON syntool.* TO 'syntool_processor'@'111.222.333.444' \
         IDENTIFIED BY 'REDACTED2';"
wget https://ftp.odl.bzh/odl/syntool/syntool.sql -O /tmp/syntool.sql
mysql syntool < /tmp/syntool.sql
```

 # Webservice installation and configuration
```
pip install https://ftp.odl.bzh/odl/arktalas/syntool/syntool_metadata-0.1.148.tar.gz
pip install uwsgi
```

 # Webservice configuration
```
mkdir -p /etc/syntool
wget https://ftp.odl.bzh/odl/syntool/syntool.ini -O /etc/syntool/syntool.ini
wget https://ftp.odl.bzh/odl/syntool/uwsgi.ini -O /etc/syntool/uwsgi.ini
wget https://ftp.odl.bzh/odl/syntool/syntool.service -O /etc/systemd/system/syntool.service
systemctl start syntool.service
systemctl enable syntool.service
```

 # Web server configuration
```
wget https://ftp.odl.bzh/odl/syntool/nginx.conf -O /etc/nginx/sites-available/syntool.conf
rm /etc/nginx/sites-enabled/default
ln -s /etc/nginx/sites-available/syntool.conf /etc/nginx/sites-enabled/syntool.conf
nginx -t
systemctl restart nginx
systemctl enable nginx
```