PALEO-SEAL: an easily deployable tool for the communication and sharing of Holocene sea-level data.

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ABSTRACT

We present a simply deployable interface that allows querying and downloading Holocene sea-level datapoints, formatted following the HOLSEA data template, hosted on a mySQL database. The interface uses AngularJS, is scalable to large datasets and can be deployed in few easy steps, that require only basic knowledge of SQL and HTML.

1. Introduction

The standardization of data on Holocene sea-level proxies has been a recurrent theme in coastal Quaternary Science research. While it was theorized and implemented at least since the early 80s (Shennan, 1982; Shennan et al., 1983; Van De Plassche, 1986), only recent work has established a comprehensive framework for the standardization of sea-level data and applied it globally (Khan et al., 2019). The sea-level data standardization efforts were elicited by different IGCP (International Geological Correlation Programme, later renamed as the International Geoscience Programme) projects and the INQUA-PAGES project PALSEA (Palaeo-Constraints on Sea-Level Rise).

A paper stemming from the PALSEA community (Düsterhus et al., 2016) highlights that the key elements to be considered when compiling a sea-level database are: Accessibility, Transparency, Trust, Availability, Continuity, Completeness, and Communication of content. This set of properties was abbreviated into the ATTAC^3 acronym. "Communication of content", according to Düsterhus et al. (2016), means that interfaces for visualization, and standardized protocols for data extraction need to be implemented to allow users from different disciplines to easily visualize and export data of interest.

In this short note, we present one tool designed to meet such criteria, called PALEO-SEAL. The tool makes use of a mySQL version of the sea-level data template of Khan et al. (2019). Installed on any web server supporting PHP and with few simple steps to set it up, it can be used to create a webpage to explore, plot and download Holocene sea-level data.

2. PALEO-SEAL description

The core of PALEO-SEAL are two main data visualization options. One is a map, where points are clustered and de-clustered at different zoom levels. Within the map, data can be filtered either by a drop-down menu or directly on the map. The drop-down menu allows for the selection of data type (type of sea-level indicator), Region, Subregion, Reference, Publication year, or Dating method. On the map, data can be filtered geographically with a "draw rectangle" tool (Figure 1). Once a subset of data is selected, it is possible to visualize it in a data explorer interface (Figure 2). The data explorer interface consists of an age/elevation graph (with adjustable X and Y axes) and a simplified table that previews the sea-level data plotted.

The data explorer interface has the same data filtering options as the map, and the two interfaces are linked: what is selected on the map will appear in the data interface and vice-versa. From both map and data explorer, it is possible to create a list of datapoints to be exported. Once filtering is complete, an "Export" button allows the selected data to be downloaded as a *.csv file, compliant with the Khan et al. (2019) template.

3. Installing PALEO-SEAL

PALEO-SEAL is available via Zenodo (link). The repository can also be forked in GitHub (link). Pre-requisites for PALEO-SEAL are a server with mySQL (where data is stored) and PhP 7 installed. Then, the following steps must be followed.

Prepare and deploy the mySQL database. The data that will be shown in PALEO-SEAL need to be hosted on a remote server, where you will have to create a mySQL database. The only privileges needed by the interface are "SELECT" and "SHOW VIEW". As the user name and password to access the database will be visible to anyone with access to the code, it is strongly suggested to create a user with only these minimal privileges dedicated to the PALEO-SEAL interface. This will protect the data from unwanted changes by non-admin users. Once the database is created, run the SQL command "create table", included in the mysql folder. This will create 79 fields, reproducing the HOLSEA data table in the mySQL database. Fields headers in the database are coded with alphanumeric codes, corresponding to the fields in the HOLSEA database. To obtain descriptions of each field, you can refer to the `data_headers_lookup.json` file in the `\data \lookups` folder. Then, data can be imported

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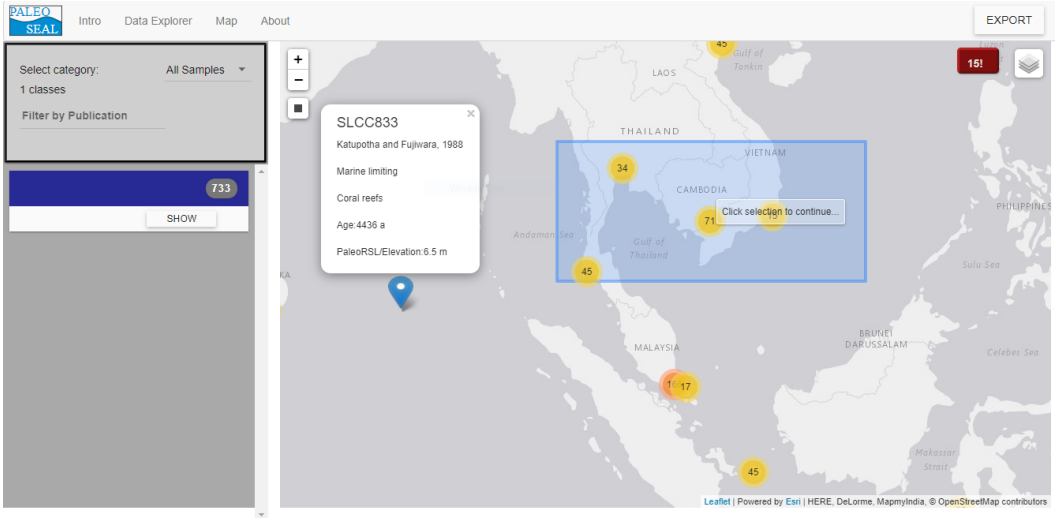

Figure 1: ALE TO DRAFT CAPTION

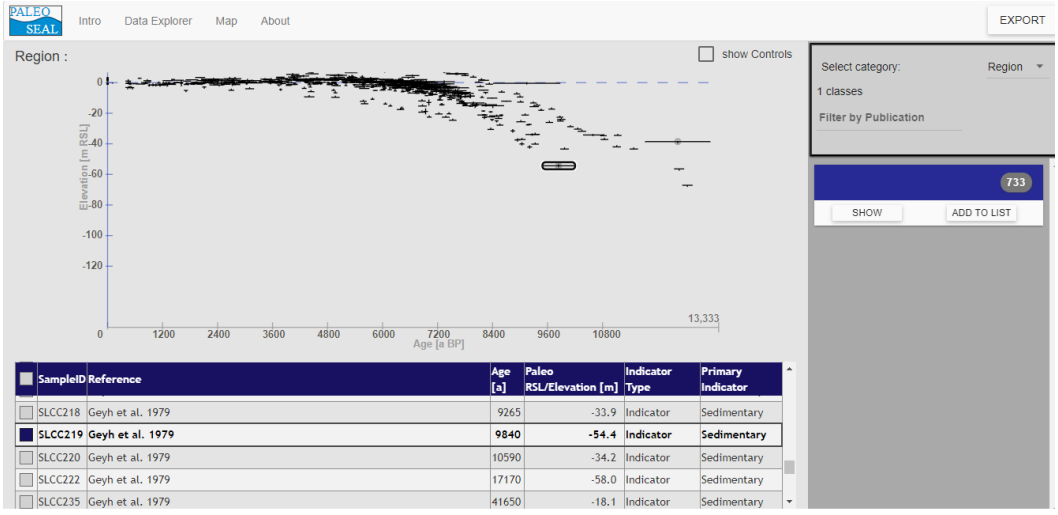

Figure 2: ALE TO DRAFT CAPTION (Maybe merge with figure 1)

into the mySQL database using common import functions from csv or excel.

Modify the connection string. Navigate to `scripts \data \connect.php` and open the file with a text editor. Edit line 3 to connect to your database as follows inserting the server name, username, password, database and port to connect to your database.

```
$con=mysqli_connect("SERVER NAME","USERNAME","PASSWORD","
    DATABASE", "PORT");
```

Deploy your application. Deploy the application by copying the entire PALEO-SEAL folder on a web server that supports PHP 7.0. The directory where PALEO-SEAL is copied needs to be publicly accessible.

Change style (optional). It is possible to change the appearance of PALEO-SEAL using HTML and CSS. For example, the logo can be changed by overwriting the `logo.svg` file in the `\common \img` folder. The webpages of the application are contained in the `\pages` folder. Text and content can be edited from here. To change the page style, it is possible to modify the `\common \css \appearance.css` file and, if necessary, the `index.php` file.

4. Technical details

PALEO-SEAL uses different libraries to interrogate the database and display data.

The map was built with following leaflet.js and ESRI directives for AngularJS:

- leaflet.js - *basic web map*
- esri-leaflet.js - *base maps*
- ui-leaflet.min.js - *user interface elements*
- angular-leaflet-directive.js - *connect AngularJS&Leaflet*

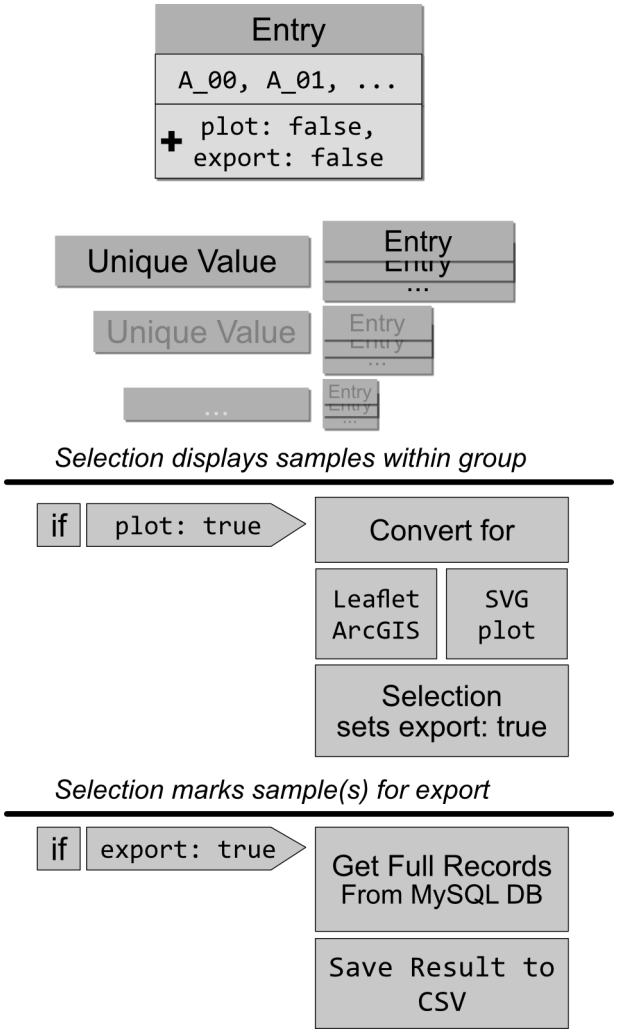

Figure 3: Data handling, processing —- JAN PLEASE DESCRIBE THIS FIGURE BETTER.

- leaflet.draw.js - *marker selection by area*
- leaflet.markercluster.js - *cluster markers based on scale*

The age/elevation graph was built using a custom scripted Scalable Vector Graphic (SVG) HTML element, extended with AngularJS directives to dynamically manage displayed data.

The map and age/elevation graph are interconnected with the AngularJS framework, which allows asyncronous storage and rendering the interface elements base on this dynamic data. The entire interface is a one-page website, rendering different outputs based on data and user choices.

5. Potential use of PALEO-SEAL

In general, PALEO-SEAL is a simple tool that can be used to illustrate, filter and make available for export Holocene sea-level data related to a paper, or a research project. For example, we deployed PALEO-SEAL to showcase the data reviewed in the context of a research project on South-East Asia sea-level proxies by Mann et al. (2019). The deployed interface is available at this link.

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