User guide

PrediWhales

Web application

English version

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The **PrediWhales** application allows the user to predict the distribution of two deep-diving cetaceans, beaked whales and sperm whales (both of them together also) and to estimate their abundance in a selected area in order to identify the areas where these species are concentrated. As these species are sensitive to underwater noise pollution, in particular to active sonars, it is necessary to plan noise-generating activities in areas where the impact would be the lowest. To do this, the application also simulates a boat trip by defining a radius of exposure around it to estimate the number of animals potentially exposed by the noise generated along this trip in the selected area. Finally, the prediction maps created can be downloaded in different formats by selecting the available options.

CONTENTS

1. Connection to the application

The application is available by following the link: http://pelabox.univ-lr.fr:3838/pelagis/PrediWhales/. **The application is launched and it only takes a few moments for the display to be complete (two maps must appear in the display area; Figure 1).**

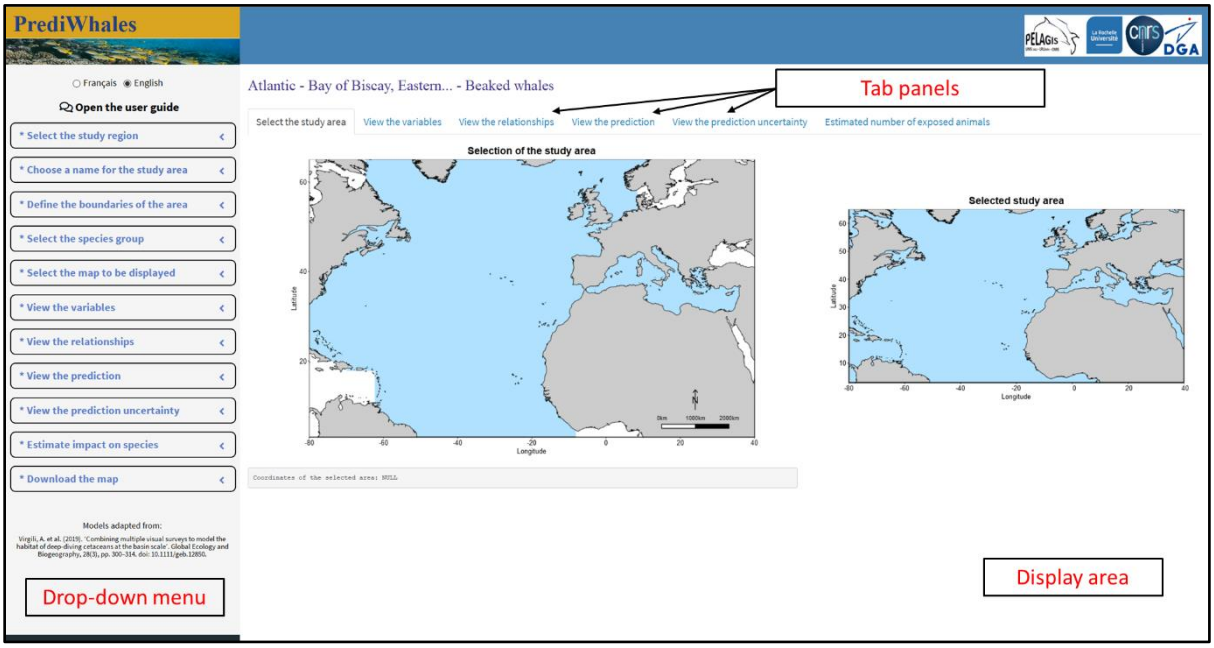

Figure 1. Interface of the PrediWhales application.

The application is divided into two panels, the **drop-down menu** on the left in which each **tab** can be expanded by clicking on it to display the options, and the **display area** on the right in which there are **six tab panels**, each corresponding to the display of a result.

The application is available in **two languages**, French and English. To choose the language, **click on the chosen language**. By default, French is selected.

In order to obtain the prediction maps, the first step is to **define the study area** in the **tab panel #1 "Select the study area"**.

2. Define the study area

The first three tabs of the drop-down menu are used to define the study area (**Figure 2**).

2.1. Select the study region

In the first tab of the drop-down menu **"Select the study region"**, the user defines the region in which the prediction will be made, namely the **Atlantic Ocean** or the **Mediterranean Sea** or **Atlantic & Mediterranean Sea**. Indeed, for each region, a model is applied so the user has to choose the right region according to where he wants to predict the distribution. If the region defined in the first tab does not correspond to the area selected later, the maps will not be displayed so **it is important to correctly define the region**.

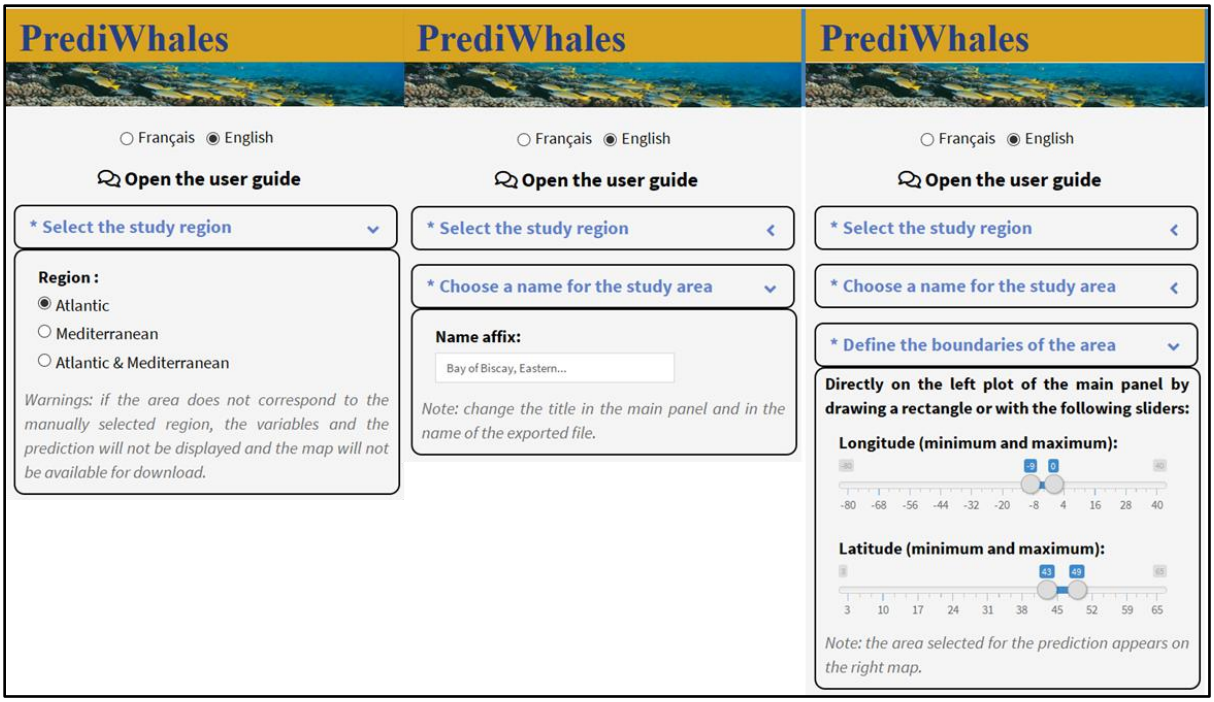

Figure 2. Tabs used to define the study area.

2.2. Choose a name for the study area

In the second tab **"Choose a name for the study area"**, a name is defined for the area that will be selected. For example, if the Bay of Biscay in the Atlantic region is targeted, it is possible to write "Bay of Biscay". Once the name has been entered in the writing area, it will be changed at the top of the display area. **The choice of this name is important because it determines the name of the exported file**. Any name/number can be written, spaces are accepted but it is better to avoid special characters to avoid any malfunction.

2.3. Define the boundaries of the area

The third tab **"Define the boundaries of the study area"**, allows selecting the area where the prediction map will be produced. For this, two options are available:

- **Select the area directly on the left map of the tab panel "Select the study Area" by drawing a rectangle** around the area of interest. It is possible to adjust the rectangle at any time by stretching the edges or selecting another rectangle. Once the rectangle is drawn, the selected area appears on the right map in the display area, the "Longitude" and "Latitude" sliders automatically move in the tab "Define study area boundaries" and the coordinates of the selected area appear below the left map in the display area.

- **Using the "Longitude" and "Latitude" sliders** in the tab **"Define the boundaries of the area "**. It is better to use the sliders if the user knows the coordinates of the area to be selected beforehand. The selected area appears on the right map in the display area.

Note: the blank areas on the left map indicate areas where prediction is not available. If the selected area is too small the resolution will be low and if it is too close to the coast, the prediction will not be available because the environmental variables used are not available near the coast.

3. Select the options

Once the area has been selected, different options are available for displaying the prediction (**Figure 3**).

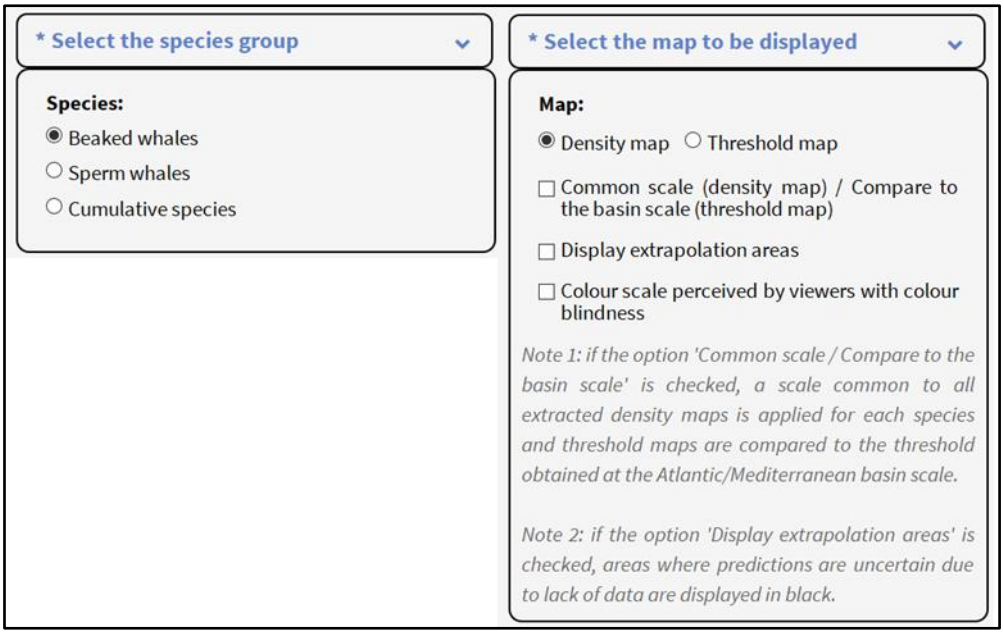

Figure 3. Tabs used to select the options available for displaying the prediction map.

3.1. Select the species

The tab **"Select the species"** allows defining the species for which the prediction will be calculated.

Three choices are available, **beaked whales, sperm whales or both species combined**. To display a new prediction, click on another species.

3.2. Select the map to be displayed

In the tab **"Select the map to be displayed"**, it is possible to define the format in which the prediction map will be displayed in the tab panels **"View the prediction"** and **"Estimated number of exposed animals"**.

Two choices are available, a **density map**, in number of individuals/100 km² or a **threshold map,** *i.e.* according to the maximum density in the selected area, four thresholds have been defined: "high, medium, low and very low densities" in order to facilitate the reading of the map.

It is also possible to **check the option "Common scale (density map) / Compare to the basin scale (threshold map)"**. If this option is checked, a common scale for all calculated density maps is applied for each species, allowing a comparison between different regions. For threshold maps, if this option is checked, densities are compared to the maximum density in the Atlantic and/or Mediterranean basin and not in the selected area, allowing a comparison between different regions.

The option "**Display extrapolation areas**" allows displaying in black on the maps the areas where the prediction is uncertain because the environmental conditions in this area were not sampled during the surveys, so we are not sure if the species is present or not in this area but the statistical model used is able to extrapolate densities in these areas. The prediction in black areas should therefore be

considered with greater caution. If this option is checked, the extrapolation areas are displayed on the maps of the tab panels "View the prediction", "View the prediction uncertainty" and "Estimated number of exposed animals".

For people with colour blindness, a suitable colour scale can be applied by **checking the option "Colour scale perceived by viewers with colour blindness".**

4. View the results

4.1. View the variables

The tab panel **"View the variables"** allows viewing the maps of the variables used to fit the models in the selected study region (**Figure 4**).

Note: depending on the selected region and species, three or four maps will be displayed. If the maps are displayed in white, the area selected in the first tab and the area selected in the third tab do not match.

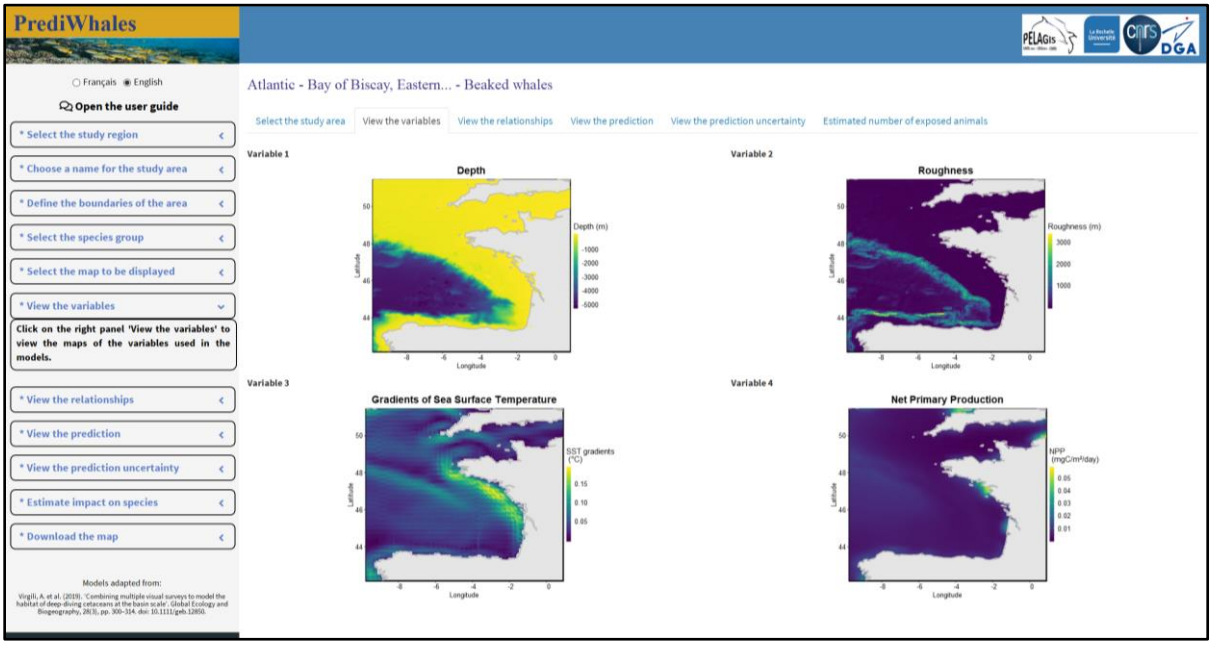

Figure 4. Viewing of the variables used in the habitat models, tab panel "View the variables".

4.2. View the relationships

The tab panel **"View the relationships"** allows viewing the functional relationships established in the habitat models with the environmental variables (**Figure 5**). Each column represents a variable. On the y-axis we find relative densities in number of individuals/100 km² and on the x-axis the values of the environmental variables. The blue region represents the 95% confidence interval.

For example in Figure 5, the first column represents the relationship between beaked whale densities and depth. Maximum densities are found for depths around 2300 m, indicating these species will favour areas where depths reach values of 2300 m. Similarly, densities are maximum for a roughness of about 1500 m, which corresponds to steep areas where canyons and seamounts are numerous. Beaked whales are also found in areas with relatively high gradients of sea surface temperature and

net primary production, indicating they will concentrate near thermal front areas where preys are concentrated.

Note: depending on the selected region and species, three or four columns may be displayed.

Figure 5. Viewing of the functional relationships established in the habitat models, tab panel "View the relationships".

4.3. View the prediction

To view the prediction map, click on the tab panel **"View the prediction"**. It may take some time to display the map.

The prediction map is displayed in **density** (**Figure 6**) if the density map option has been checked or in **threshold** (**Figure 7**) if the threshold map option has been checked. The red colours (yellow for the colour scale adapted to colour blindness) indicate high densities while blue colours indicate low densities. For example, in Figure 6, the highest densities of beaked whales are predicted near the continental slope with maxima in the northern Bay of Biscay.

If the option " Common scale (density map) / Compare to the basin scale (threshold map)" is checked, the scale will automatically be modified and identical regardless of the selected area.

If the density map is selected, the predicted abundance in the area is displayed in the upper right-hand corner of the display area with the confidence intervals ([min, max]). Be careful, this value is an estimate that does not consider the availability bias of the animals at the surface and the detection bias linked to the observer (*i.e.* the animal was present but the observer did not see it) so the value is underestimated.

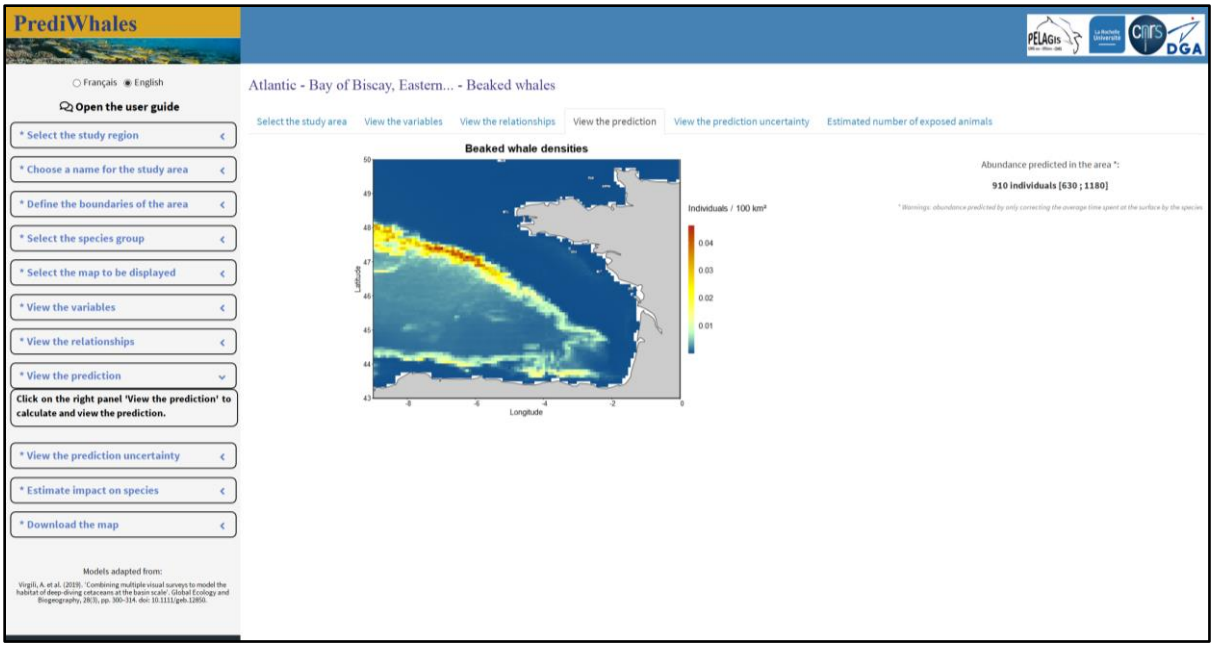

Figure 6. Viewing of the density prediction map (individuals/100 km²), tab panel "View the prediction".

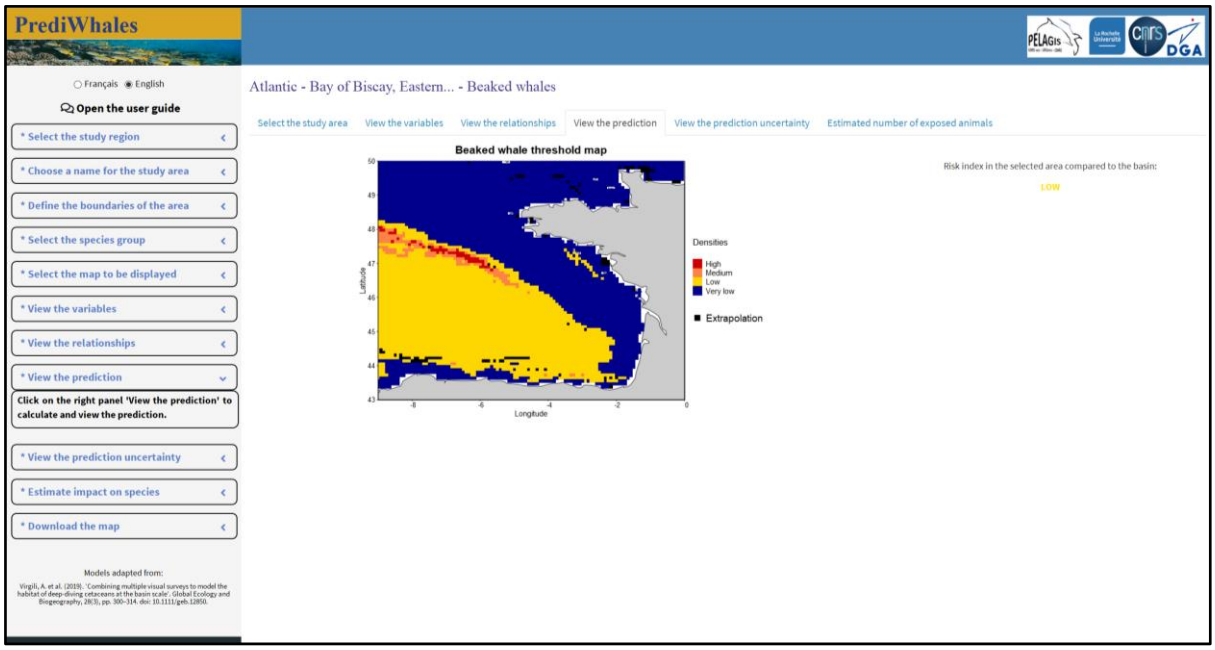

Figure 7. Viewing of the threshold prediction map with the extrapolation areas in black, tab panel "View the prediction".

If the threshold map is selected, the risk index in the selected area is compared to the one of the Atlantic and/or Mediterranean basin. If the threshold is high, the selected area represents an area of high density compare to the basin scale, while if the risk is low, it is an area of low density compare to the basin scale.

Note: if the maps are displayed in white, the region selected in the first tab and the area selected in the third tab do not match. If the colours are displayed but some areas remain white, the prediction is not available in this area.

4.4. View the prediction uncertainty

The tab panel "View the prediction uncertainty" allows viewing the uncertainty associated with the prediction (**Figure 8**). Indeed, there are always statistical errors associated with the models and uncertainty estimates them. The lower the uncertainty, the more accurate the results. Here, for example, for an estimated density of 0.05 individuals / 100 km², the standard error is 0.01 individuals / 100 km², which means that in reality the estimated density is 0.05 ± 0.01 individuals / 100 km².

Note: if the maps are displayed in white, the region selected in the first tab and the area selected in the third tab do not match.

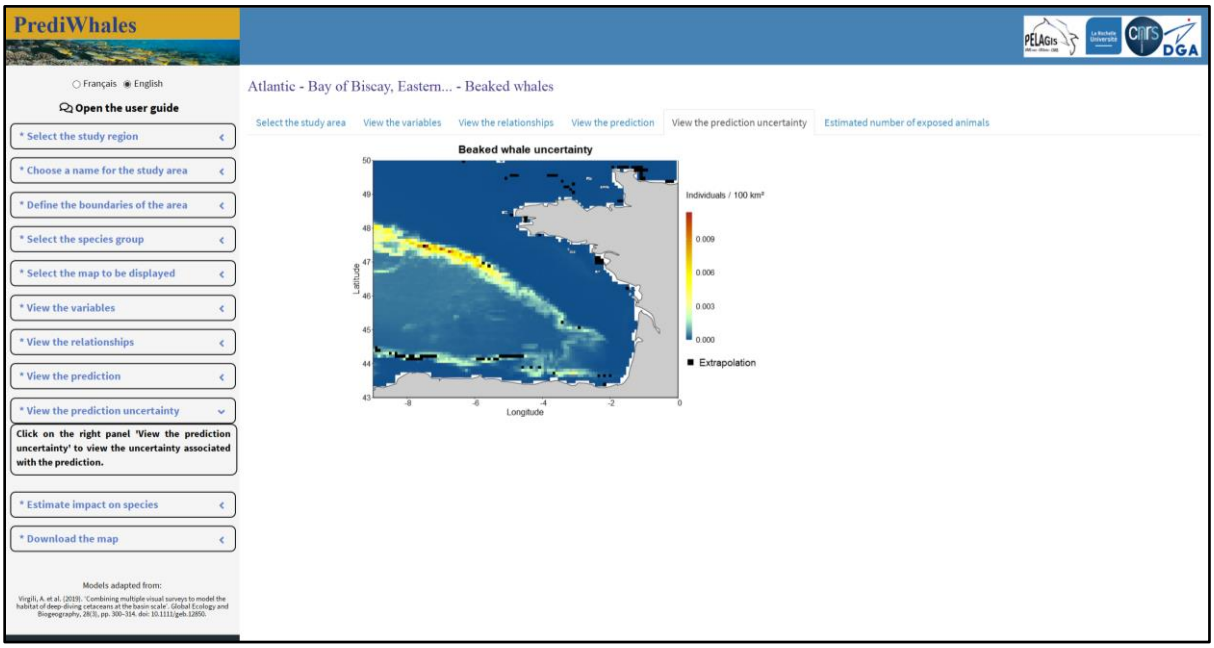

Figure 8. Map viewing of the uncertainty associated with the prediction with the extrapolation areas in black, tab panel "View of the prediction uncertainty".

5. Estimate impact on species

The PrediWhales application also makes it possible to estimate the number of animals potentially exposed to a boat that would emit noise disturbances. To do this, click on the tab panel **"Estimated number of exposed animals"** and let the map appear (few seconds; **Figure 9**). The map displayed is the same as in the tab panel "View the prediction", to modify it, user has to modify the options in the tab "Select the map to be displayed".

Once the map is displayed, the user can enter in the table on the right, the coordinates of the boat to simulate a trip (a line in the table corresponds to a point on the map). The coordinates of the trip have to match the boundaries of the study area to be displayed. If the user fills a line, a red dot will appear on the map, from 2 lines, a red path will appear. Any point can be modified by clicking on the cell of the table. A black dotted area also appears around the point or path, which corresponds to the exposure radius of the noise disturbance. This radius can be modified in the tab **"Estimate impact on species"** by choosing an exposure radius of 5, 10, 20 or 50 km. When the trip is simulated, the estimated number of exposed animals appears at the bottom right of the display area. Two pieces of information are provided, the **number of exposed animals** with the associated confidence interval and the **percentage of the population this represents in the selected area**. The larger the selected

exposure radius, the more important the values will be. For example in Figure 9, the selected exposure radius is 5 km and the simulated path would expose about 10 individuals or 1.1 % of the population in the selected area (here the Bay of Biscay). Be careful, this value is an estimate that does not consider the availability bias of the animals on the surface and the detection bias linked to the observer (*i.e.* the animal was present but the observer did not see it) so the value is underestimated (the percentage of exposed animals does not vary).

Note: to delete the value of a cell, write 0 in the cell.

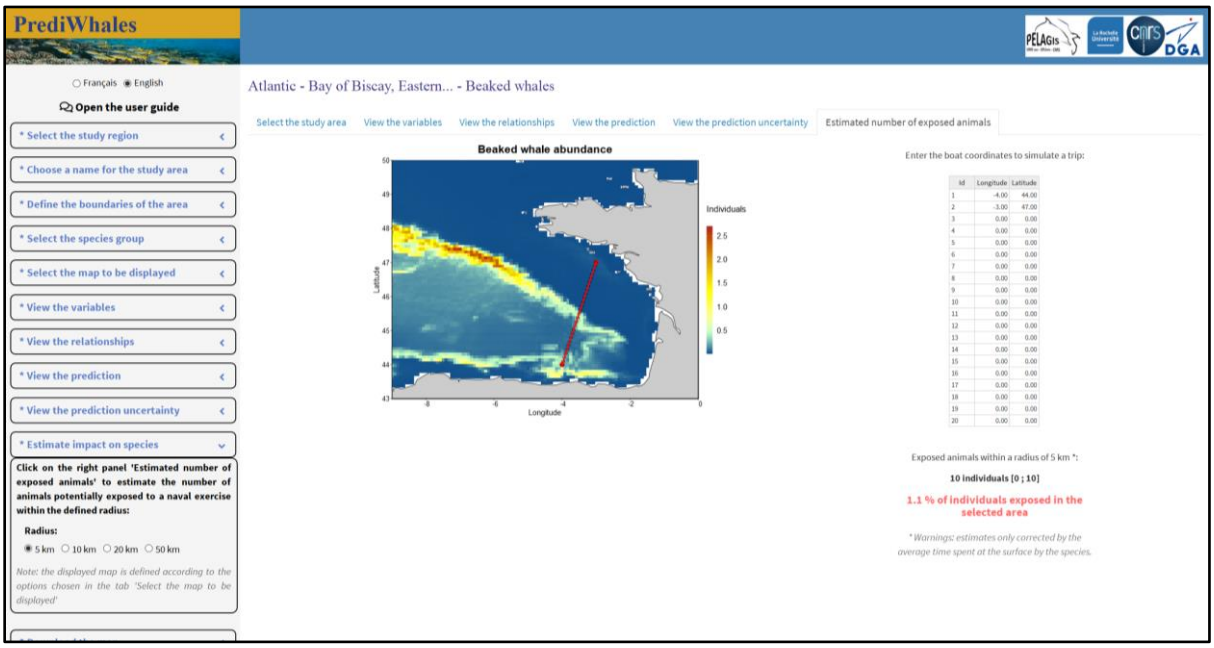

Figure 9. View of a boat trip simulation and estimation of the number of exposed animals considering an exposure radius of 20 km, tab panel "Estimated number of exposed animals".

6. Download the map

In addition to viewing the prediction map, it is possible to download it using the tab **"Download the map"** in the drop-down menu (**Figure 10**). Various options are available to download the map, the number of downloads is not limited and the file name will depend on the options selected. Once the options have been selected, the user **clicks on the "Download the map" button**.

The first choice allows defining whether the user wants to obtain a **distribution map**, obtained from the tab panel "View the prediction", or an **impact map**, obtained from the tab panel "Estimated number of exposed animals".

Note: to download a distribution map it is necessary to have previously clicked on the tab panel "View the prediction" and to obtain an impact map it is necessary to have previously clicked on the tab panel "Estimated number of exposed animals".

With the various available options, it is possible to:

- Select the **density map** or **threshold map**,
- Apply a common scale to all maps or compare the density with the one of the Atlantic and/or Mediterranean basin by **checking " Common scale (density map) / Compare to the basin scale (threshold map)"**,
- Display extrapolation areas where the prediction is uncertain,

- Display additional information in the figure such as the estimated abundance or the number of exposed animals by **checking "Display estimated abundance (distribution map) / Display number of exposed animals (impact map)"**,
- **Apply a colour scale adapted to people with colour blindness** by **checking** the option,
- **Choose the file extension** (jpeg, png, pdf or tiff).

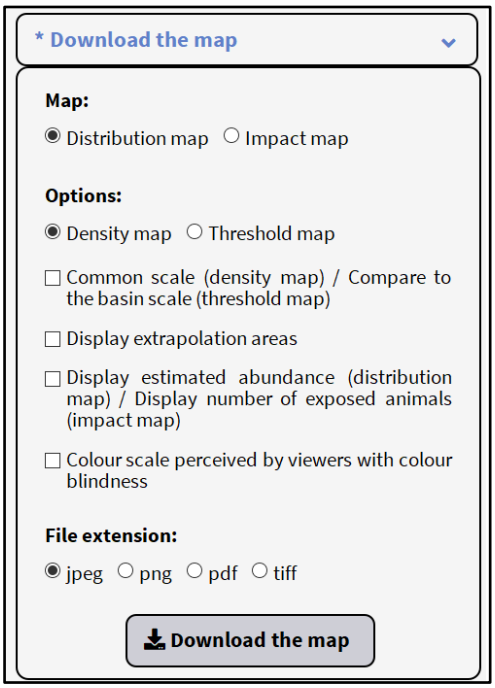

Figure 10. Tab used to download the map after the prediction calculation.

7. Create new maps

At any time (before or after downloading the files), to create new maps it is possible to modify the area from the tab "Define the boundaries of the study area" or the tab panel "Select study area", the species from the tab "Select species", the map format (density or threshold) from the tab "Select map to be displayed". When the new options are selected, the user must **click again** on the tab panel **"View the prediction"** to display the prediction calculation.

All maps can be downloaded from the tab "Download the map".

8. Technical support

For any questions, please contact Auriane Virgili, auriane.virgili@univ-lr.fr.