

# **APSAP\_Sherd\_Matching\_Tool**

## **User Guide**

# Introduction

Piecereg is an application that generates 3d models from pictures. However, the 3d models it generates are unordered in **batch** folders. These 3d models should be put inside the **find** folder of a specific find. APSAP helps you to do that. APSAP is a desktop application written with Python and PYQT. Its purpose is to assist researchers in archaeology to match 3d models and 2d images. This user guide shows the user how to use the application to match finds with 3d models.

# The interface

## Introduction

This section explains all the components in the GUI of the application.

The screenshot shows the 'Sherd Match Assistance' application window. It features a top section for location data (Hemisphere, Zone, Easting, Northing, Context), a middle section for filtering (Color Grid, Find Filter, Batch Filter), a central display area with a list of sorted models and two image thumbnails, and a bottom section for match management (Find #, Year, Batch, Piece, Current Value, New Value). Five blue arrows point from specific parts of the interface to callout boxes on the right:

- Setting folder:** Points to the Context dropdown menu.
- Filter and load batches:** Points to the Find Filter and Batch Filter sections.
- Display and selecting:** Points to the central display area showing sorted models and images.
- Current selected and updating:** Points to the match management section at the bottom.
- Current operation:** Points to the status bar at the very bottom.

As you can see, the interface can be grouped into five parts. Each of the five parts will be thoroughly discussed.

## Setting the folder

Hemisphere	Zone	Easting	Northing	Context
N	38	478130	4419430	77

As what we are trying to do is to match all 3d models and all finds in a certain context, these five drop down lists (**Hemisphere, Zone, Easting, Northing and Context**) can be adjusted to allow the user to choose the context they want to consider. These values correspond to folders on the file system where the information about the finds and the 3D models are stored.

When a context is changed by the user, two things happen:

1. The interface is cleared in the sense that previously displayed text, pictures and models and cleared from the interface
2. The Find Filter and Batch Filter, which will be discussed in the next section, will update their range of possible values to correspond to the values available in the newly selected context.

Note that images and 3D models are **not** automatically loaded when a context is selected.

## Filter and load batches

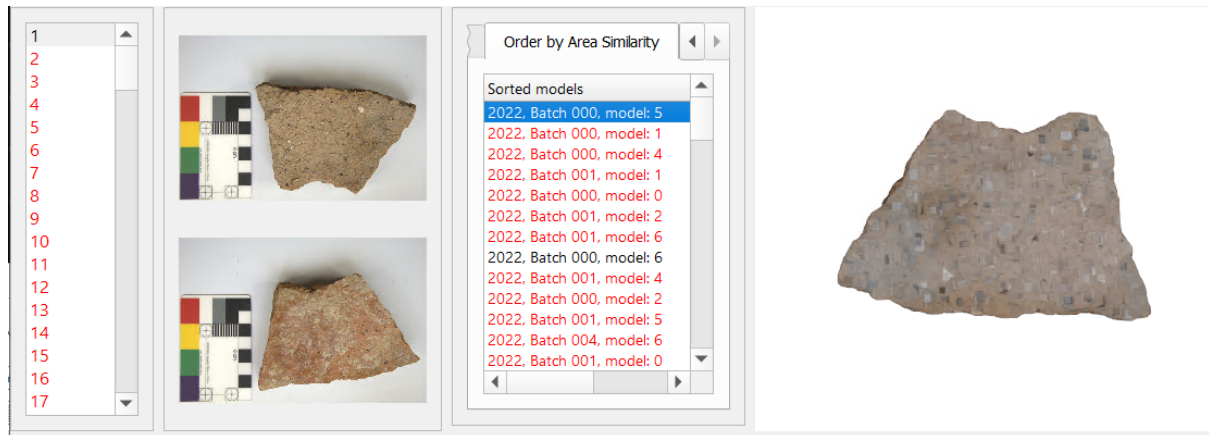
The interface consists of several sections: a context label 'N-38-478130-4419430-82', a 'Color Grid' section with a color grid image and a 'Default' dropdown, a 'Find Filter' section with 'Find Start' (1) and 'Find End' (132) inputs, a 'Year' input (2022), a 'Batch Filter' section with 'Batch Start' (0) and 'Batch End' (6) inputs, and a 'Load' button.

This section has four subsections.

1. **Context label:** A text that shows the current context under consideration. (E.g. **N-38-478130-4419430-82**)
2. **Color Grid Selector:** A drop down list that allows you to choose the **color grid** for the currently selected images. Every find is photographed next to a color grid. However, one of several different grids may be used. The APSAP software uses the known dimensions of the color grid to measure the find object in the photograph, so the correct grid must be selected in order for the measurements to be accurate.
3. **Find and batch filters:** These allow the user to limit which finds and which batches will be considered together for matching. This may be done if the user has knowledge that specific finds within a particular range of batches of 3d models.
4. **Load button:** Once the desired context has been selected and any filters have been applied, pressing the Load button will tell the program to read through the directory of the appropriate context and collect all of the find photos and 3D models it contains in its subdirectories. The program will also measure the area, width-length, and contour of each 3D model (which may take some time) or retrieve these values from a cache if they have been loaded previously.

It should be noted that if the context is loaded for the first time, it will take a while to measure all the pixels for all the 3d models in the context. Any subsequent loading of the context, however, takes much less time because the measured results are cached. When the CPU and GPU of the server are not under great utilization, it takes less than half a second to measure a 3d model.

## Display and selecting



This section has a total of four parts

1. **Finds List:** A **selection list of all the finds** in the context retrieved from the folders under finds/individual in the context folder . If the find is black, it means the find is not matched before. If the find is red, it means it has been matched before. Clicking on a find number in the list will do two things:
  - a. The photographs for the selected find will be displayed immediately to the right.
  - b. The selection list under the tab **Order by Area Similarity** will update to show the 3D models in the context sorted in the order from the most similar to the least similar, with respect to the current selected find.
2. **Find Photos:** The **2 jpegs** that tell you what the find looks like as mentioned previously.. Note that in the picture it has the color grid in it. As mentioned in the previous section, you can choose the color grid in the Filter and load Batches section. Only by choosing the correct color grid according to the images displayed here, will the calculation of the similarity be accurate. By clicking on the images, a larger image will pop up so you can check it much more clearly to see if the 3d model displayed on the right side is the same as this find.
3. **3D Model List:** As already mentioned, the third section contains a list of 3D models sorted in order of their similarity to the currently selected find. By clicking the icon to the left of the text of “**Order by Area Similarity**”, you can choose to select the 3D models ordered by year, batch and piece number, instead of by similarity.
4. **3D Model Display:** Lastly, there is a window that **displays the 3D model**. This is an interactive display that allows the user to rotate, zoom, and pan around the model to view it from all angles.

## Current selected and updating

Find # 7 =	Year: 2022	Batch: 1	Piece: 4	Current Value
Remove match Update	Year: 2022	Batch: 1	Piece: 0	New Value

This section can be divided into four components

1. **Selected Find:** The top left corner displays the **currently selected find**, which is set when you click on an item on the selection list of all the finds mentioned in the last section.
2. **Match Controls:** The bottom left corner has two buttons, **Remove Match** and **Update**. That will change which 3D model is associated with the current find by updating the relevant records in the database.
  - a. **Remove Match** will unassociate the currently selected 3D model with the currently selected find. As a result the Current Value for Year, Batch and Piece will be changed to NS for “Not Set”. In the database the values for these fields in the record of the find will be set to NULL.
  - b. **Update** will **change** the 3D model associated with the currently selected find to the currently selected 3D model. That is, the fields year, batch, and piece for the database record of the currently selected find will be changed to the values for the currently selected 3D model.

Note that both buttons will ask for confirmation before you do the operation. Note that by **updating**, the current find’s inner folder will be pasted with a copy of the original 3d model and the downsampled 3d model from the origin.

The colors of the items will change from black to red, or black to red when **updating and removing buttons** are clicked, to reflect if the find or the 3d model is matched or not.

3. To the right there are two rows of values for Year, Batch, and Piece of a 3D model. The top row indicates the **matched** 3D model in the database for the current find. In the case there is no 3D model matched to the current find, the columns should display **NS(Not Set)**
4. The bottom row on the right contains the **Year, Batch, Piece** values for the **currently selected** 3D model. These are the values that will be set by clicking the **Update** button.

## Current operation

```
Calculate the similarity with D:  
\\ararat\data\files\N\38\478130\4419430\82\finds\3dbatch\2022\batch_006\registration_reso1_maskthres242\final_output\piece_9_world_sample0_3_mest
```

Finally, the last row of the interface displays the current operation of the application so that you know the application is doing something when it is loading. Note that when the CPU or the GPU is heavily in use, the application may freeze for a brief moment when the application is loading.

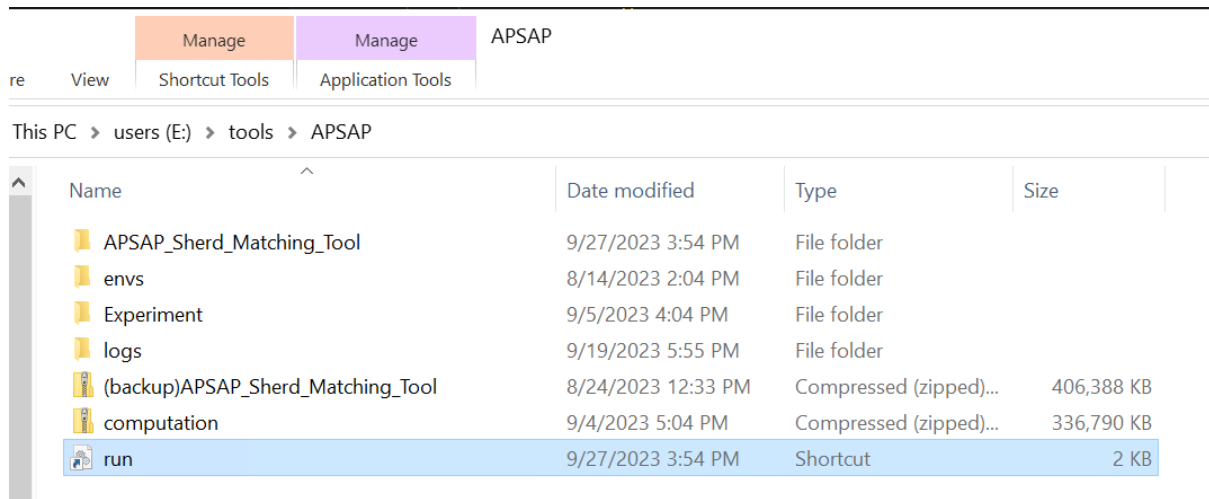


# Normal User Flow

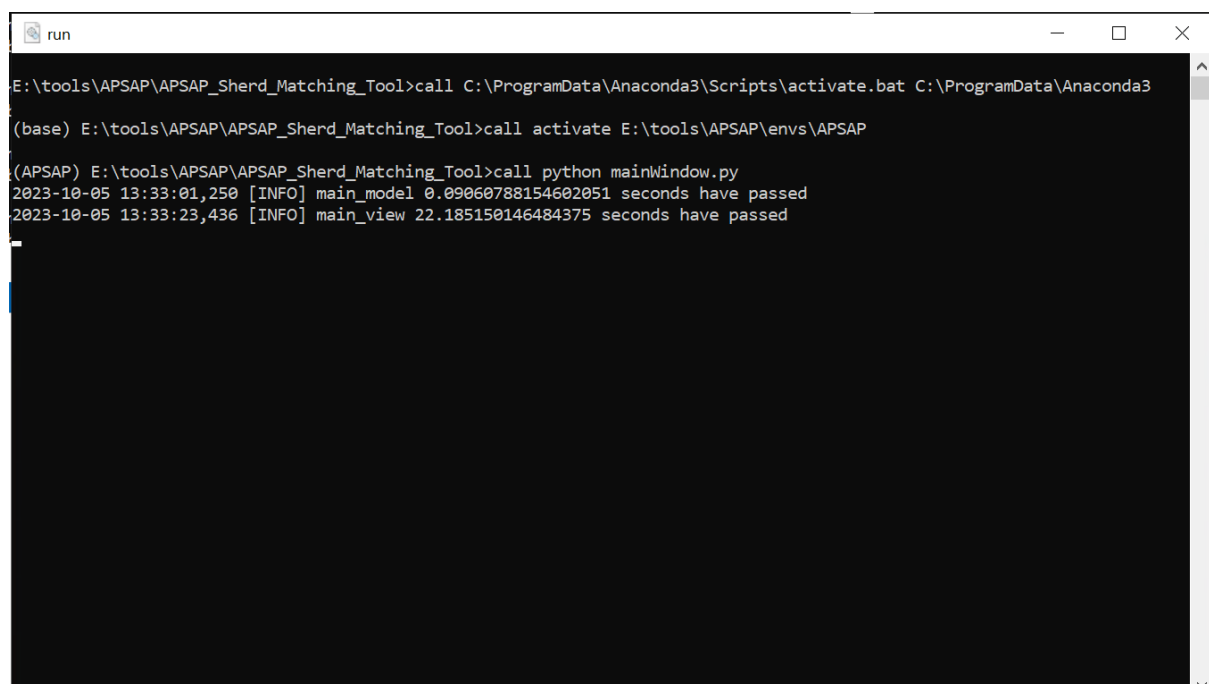
## Introduction

This section demonstrates how the user uses the application.

1. Start the program by clicking on the run file in the folder E:\tools\APSAP



2. A command prompt will appear. There will be a wait of around 30 to 60 seconds for the initial loading of the 3D model processing library.



- The application will look like this after loading is finished.

The screenshot shows the 'Sherd Match Assistance' application window. At the top, there are five dropdown menus: Hemisphere (N), Zone (38), Easting (478020), Northing (4419550), and Context (1). Below these are three main sections: 'Color Grid' (with a 'Default' color bar), 'Find Filter' (with 'Find Start' at 1, 'Find End' at 1, and 'Year' at 0), and 'Batch Filter' (with 'Batch Start' at 0 and 'Batch End' at 0). A 'Load' button is to the right of the filters. The central area contains a large empty box with a tab labeled 'Order by Area Similarity'. At the bottom, there are two rows of input fields and buttons. The first row has 'Find #', '=', 'Year:', 'Batch:', 'Piece:', and 'Current Value'. The second row has 'Remove match', 'Update', 'Year:', 'Batch:', 'Piece:', and 'New Value'.

- Use the drop down menus along the top to select the context that you want to do the matching on (478130, 4419430, 74) is chosen in this case. Note the filter's values update to reflect what is in the context. A grayed out value in the drop down menu indicates that this is the only available value given the other selected options. For example in the image below 4419430 is the only available Northing under the Easting of 478130.

This screenshot shows the same application window with updated settings. The Hemisphere is still 'N', Zone is '38', but Easting is now '478130' and Northing is '4419430'. The Context dropdown now shows '74' as the only available option, which is highlighted in gray. The 'Find Filter' section has updated its values: 'Find Start' is 1, 'Find End' is 292, and 'Year' is 2022. The 'Batch Filter' section has updated 'Batch Start' to 0 and 'Batch End' to 25. The 'Load' button remains. The central area still has the 'Order by Area Similarity' tab. The bottom input fields and buttons are the same as in the previous screenshot.

- (Optional) Adjust the filters so it only loads finds and batches in a specific range

The screenshot shows the 'Sherd Match Assistance' application window. At the top, there are five dropdown menus: Hemisphere (N), Zone (38), Easting (478130), Northing (4419430), and Context (74). Below these are three filter sections: 'Color Grid' with a 'Default' color selection, 'Find Filter' with 'Find Start' (140), 'Find End' (292), and 'Year' (2022), and 'Batch Filter' with 'Batch Start' (16) and 'Batch End' (25). A 'Load' button is to the right of the Batch Filter. The main area contains a 'Find #' list on the left, a 'Color Grid' in the center, and a 'Batch Filter' on the right. At the bottom, there are two rows of input fields for 'Find #', 'Year', 'Batch', and 'Piece', with 'Current Value' and 'New Value' labels.

- When the desired context is selected and any adjustments to the filters are made, press the **Load** button.. The application will load all the finds from the context in the selection list from the left. Time is also spent on measuring the 3d models inside the context. In case the 3d models have not been measured before, it will take some time to measure them(around 0.3 second for 1 model). In case the 3d models have been measured already, the application loads the measured values from the cache, which means the time to load the models is greatly reduced. Red items means the find has a matched 3d model already.

The screenshot shows the 'Sherd Match Assistance' application window after loading finds. The 'Find #' list on the left now contains a range of numbers from 140 to 157. The 'Color Grid' in the center is still 'Default'. The 'Batch Filter' on the right is still set to 'Batch Start' (16) and 'Batch End' (25). The 'Load' button is still present. At the bottom, there are two rows of input fields for 'Find #', 'Year', 'Batch', and 'Piece', with 'Current Value' and 'New Value' labels. A status bar at the bottom indicates 'Loading find in folder D:\ararat\data\files\N\38\478130\4419430\74\finds\individual\292\photos'.

- Click on a number from the **Finds List** to select it. You should notice this triggers two actions. First, two images are getting displayed. These images are clickable. When you click the images, a much larger window will pop up such that you can check the images more precisely. Second, the Order by Area Similarity list is filled with 3d models for you to select. The list is sorted by similarity. So naturally, the first item is the 3d model that is most similar to the 2 jpegs on the left.

As you can see, in the lower part of the application, it shows **Year: 2022, Batch: 17, Piece: 9, Current Value**. This means that the find **140** already has a matched model, that is the model from year **2022**, in the batch **17**, with the piece number **9**. Because the model is already matched, it is red in the list.

Sherd Match Assistance

Hemisphere

Zone

Easting

Northing

Context

N

38

478130

4419430

74

Color Grid

Find Filter

Batch Filter

N-38-478130-4419430-74

Default

Find Start

Find End

Year

Batch Start

Batch End

Load

140

141

142

143

144

145

147

148

149

150

151

152

153

154

155

156

157

Sieve

Order by Area Similarity

Sorted models

2022, Batch 017, model: 9

2022, Batch 017, model: 10

2022, Batch 018, model: 1

2022, Batch 017, model: 3

2022, Batch 017, model: 6

2022, Batch 016, model: 3

2022, Batch 016, model: 6

2022, Batch 016, model: 10

2022, Batch 017, model: 8

2022, Batch 016, model: 8

2022, Batch 018, model: 8

2022, Batch 016, model: 5

2022, Batch 017, model: 4

Find #

140

=

Year:

2022

Batch:

17

Piece:

9

Current Value

Remove match

Update

Year:

Batch:

Piece:

New Value

Calculate the similarity with D:

\\ararat\data\files\N\38\478130\4419430\74\finds\3dbatch\2022\batch\_025\registration\_reso1\_maskthres242\final\_output\piece\_9\_world\_sample0\_3\_mest

8. Now we select an unmatched find, 152, as indicated by its color black. The 3D models will automatically sort from most similar to least similar.. The ideal case will be that the first item on the model list, **2022, Batch 017, model: 5**, will be the model of this find. Let's click it to see if this is the case.

Sherd Match Assistance

Hemisphere: N Zone: 38 Easting: 478130 Northing: 4419430 Context: 74

**Color Grid** **Find Filter** **Batch Filter**

N-38-478130-4419430-74

Find Start: 140 Find End: 292 Year: 2022 Batch Start: 16 Batch End: 25 Load

Order by Area Similarity

Sorted models

- 2022, Batch 017, model: 5
- 2022, Batch 021, model: 9
- 2022, Batch 020, model: 12
- 2022, Batch 019, model: 12
- 2022, Batch 020, model: 0
- 2022, Batch 018, model: 5
- 2022, Batch 018, model: 3
- 2022, Batch 019, model: 2
- 2022, Batch 022, model: 9
- 2022, Batch 016, model: 8
- 2022, Batch 019, model: 1
- 2022, Batch 016, model: 6
- 2022, Batch 020, model: 16

Find # 152 = Year: NS Batch: NS Piece: NS Current Value

Remove match Update Year: 2022 Batch: 17 Piece: 5 New Value

Calculate the similarity with D:  
 \ararat\data\files\N\38\478130\4419430\74\finds\3dbatch\2022\batch\_025\registration\_reso1\_maskthres242\final\_output\piece\_9\_world\_sample0\_3\_mes

9. Well, this doesn't look too similar. Let's rotate the 3d model to see if it is the 3d model.

Sherd Match Assistance

Hemisphere: N Zone: 38 Easting: 478130 Northing: 4419430 Context: 74

**Color Grid** **Find Filter** **Batch Filter**

N-38-478130-4419430-74

Find Start: 140 Find End: 292 Year: 2022 Batch Start: 16 Batch End: 25 Load

Order by Area Similarity

Sorted models

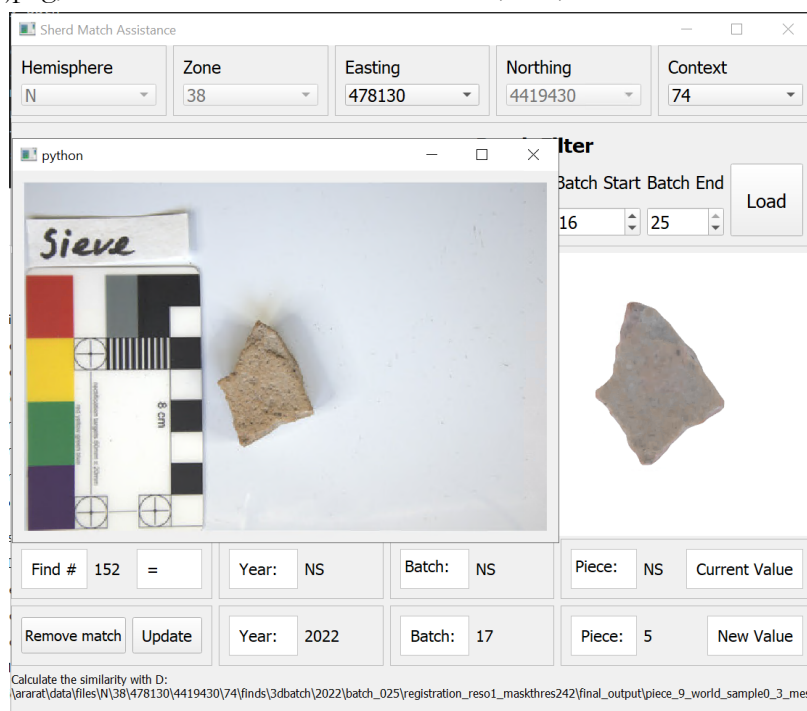
- 2022, Batch 017, model: 5
- 2022, Batch 021, model: 9
- 2022, Batch 020, model: 12
- 2022, Batch 019, model: 12
- 2022, Batch 020, model: 0
- 2022, Batch 018, model: 5
- 2022, Batch 018, model: 3
- 2022, Batch 019, model: 2
- 2022, Batch 022, model: 9
- 2022, Batch 016, model: 8
- 2022, Batch 019, model: 1
- 2022, Batch 016, model: 6
- 2022, Batch 020, model: 16

Find # 152 = Year: NS Batch: NS Piece: NS Current Value

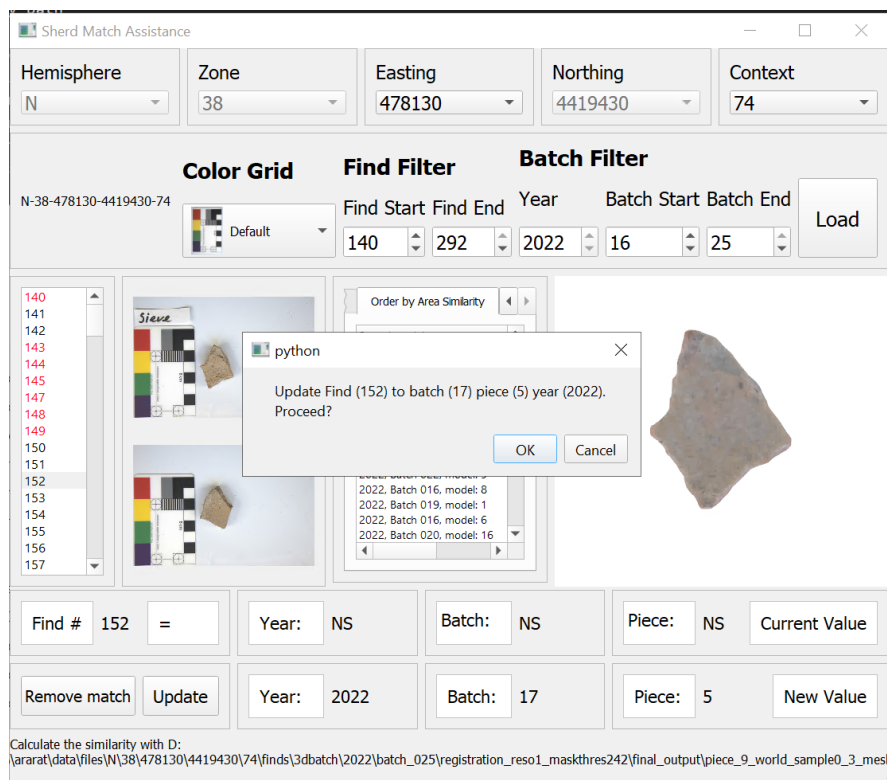
Remove match Update Year: 2022 Batch: 17 Piece: 5 New Value

Calculate the similarity with D:  
 \ararat\data\files\N\38\478130\4419430\74\finds\3dbatch\2022\batch\_025\registration\_reso1\_maskthres242\final\_output\piece\_9\_world\_sample0\_3\_mes

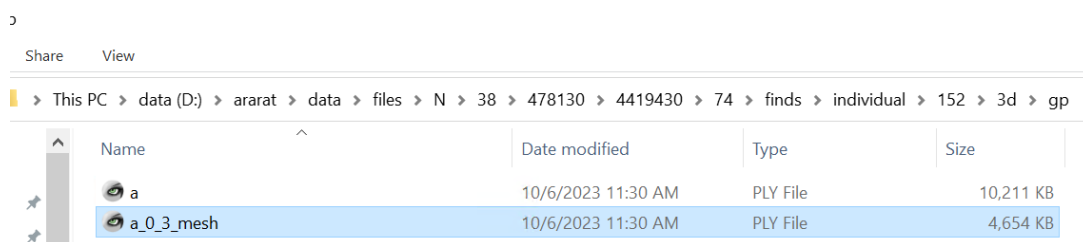
10. After rotating the 3d model using the mouse, and clicking on the image to check the jpeg, we can see that the 3d model **2022, 017, 05** does match the find!



11. Now we know that this is the 3D model that we want to match to the find. We can click on the update button in the lower part of the GUI. A dialog will pop up to ask for confirmation. When we click **OK**, it may take a few seconds to process the 3D models before they get moved to the find folder. One important detail is this: if you match a 3D model that is previously matched to a find already, the previous matched find will be unmatched in the database.



12. After the 3d model is matched, the find in the find\_list will turn to red, the 3d model in the model lists will turn to red as well. But most importantly, the 3D models will be copied to a subfolder of the find folder. As you can see, the original 3D model and the downsampled one are copied to 152/3d/gp.



13. Sometimes you may have mismatched a model and you want to update it to the database. For example, the find **155** is mismatched to the model **2022, 18, 4**.

Sherd Match Assistance

Hemisphere: N Zone: 38 Easting: 478130 Northing: 4419430 Context: 74

**Color Grid** **Find Filter** **Batch Filter**

N-38-478130-4419430-74

Find Start: 140 Find End: 292 Year: 2022 Batch Start: 16 Batch End: 25 Load

Order by Area Similarity

Sorted models:

- 2022, Batch 016, model: 7
- 2022, Batch 018, model: 4
- 2022, Batch 017, model: 8
- 2022, Batch 016, model: 6
- 2022, Batch 016, model: 3
- 2022, Batch 017, model: 7
- 2022, Batch 016, model: 8
- 2022, Batch 017, model: 3
- 2022, Batch 020, model: 12
- 2022, Batch 017, model: 5
- 2022, Batch 021, model: 5
- 2022, Batch 019, model: 9
- 2022, Batch 019, model: 12

Find # 155 = Year: 2022 Batch: 18 Piece: 4 Current Value

Remove match Update Year: 2022 Batch: 18 Piece: 4 New Value

Calculate the similarity with D:  
 \ararat\data\files\N\38\478130\4419430\74\finds\3dbatch\2022\batch\_025\registration\_reso1\_maskthres242\final\_output\piece\_9\_world\_sample0\_3\_mes

14. By clicking the remove match button and confirm it, you can see that the 3d model is no longer matched with the find.

Sherd Match Assistance

Hemisphere: N Zone: 38 Easting: 478130 Northing: 4419430 Context: 74

**Color Grid** Find Filter Batch Filter

N-38-478130-4419430-74

Find Start Find End Year Batch Start Batch End Load

140 141 142 143 144 145 146 147 148 149 150 151 152 153 154 155 156 157

Order by Area Similarity

Sorted models

2022, Batch 016, model: 7  
2022, Batch 018, model: 4  
2022, Batch 017, model: 8  
2022, Batch 016, model: 6  
2022, Batch 016, model: 3  
2022, Batch 017, model: 7  
2022, Batch 016, model: 8  
2022, Batch 017, model: 3  
2022, Batch 020, model: 12  
2022, Batch 017, model: 5  
2022, Batch 021, model: 5  
2022, Batch 019, model: 9  
2022, Batch 019, model: 12

Find # 155 = Year: NS Batch: NS Piece: NS Current Value

Remove match Update Year: 2022 Batch: 16 Piece: 7 New Value

Calculate the similarity with D:  
\\ararat\data\files\N\38\478130\4419430\74\finds\3dbatch\2022\batch\_025\registration\_reso1\_maskthres242\final\_output\piece\_9\_world\_sample0\_3\_mes

15. The last feature worth mentioning is that you are able to change the color grid. Sometimes the image has a **different color grid**. For instance, this find in this context has images with a different color grid from the default one, as you can see, the correct 3D model is not the first item of the list. What one should do in this case is to change the **color grid** in the selection list left to the **Find Filter**.

Sherd Match Assistance

Hemisphere: N Zone: 38 Easting: 478130 Northing: 4419430 Context: 1

**Color Grid** Find Filter Batch Filter

N-38-478130-4419430-1

Find Start Find End Year Batch Start Batch End Load

67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83

Order by Area Similarity

Sorted models

2022, Batch 012, model: 8  
2022, Batch 012, model: 2  
2022, Batch 014, model: 5  
2022, Batch 014, model: 9  
2022, Batch 009, model: 3  
2022, Batch 010, model: 4  
2022, Batch 001, model: 1  
2022, Batch 010, model: 1  
2022, Batch 015, model: 9  
2022, Batch 012, model: 7  
2022, Batch 008, model: 8  
2022, Batch 012, model: 6  
2022, Batch 012, model: 3

Find # 73 = Year: NS Batch: NS Piece: NS Current Value

Remove match Update Year: 2022 Batch: 15 Piece: 9 New Value

Calculate the similarity with D:  
\\ararat\data\files\N\38\478130\4419430\1\finds\3dbatch\2022\batch\_015\registration\_reso1\_maskthres242\final\_output\piece\_9\_world\_sample0\_3\_mes



16. After changing the color grid, the program will recalculate the similarity to the 3D models and the first item in the model list is indeed the correct 3D model.

Sherd Match Assistance

Hemisphere

N

Zone

38

Easting

478130

Northing

4419430

Context

1

Color Grid

Find Filter

Batch Filter

N-38-478130-4419430-1

24ColorCard

Find Start

Find End

Year

Batch Start

Batch End

Load

67

68

69

70

71

72

73

74

75

76

77

78

79


80

81


82

83

Color Grid



Color Grid



Order by Area Similarity

Sorted models

2022, Batch 015, model: 9

2022, Batch 012, model: 8

2022, Batch 008, model: 2

2022, Batch 015, model: 17

2022, Batch 015, model: 5

2022, Batch 012, model: 2

2022, Batch 015, model: 4

2022, Batch 012, model: 4


2022, Batch 001, model: 1

2022, Batch 014, model: 7

2022, Batch 009, model: 3

2022, Batch 008, model: 8

2022, Batch 014, model: 9



Find #

73

=

Year:

NS

Batch:

NS

Piece:

NS

Current Value

Remove match

Update

Year:

2022

Batch:

15

Piece:

9

New Value

Calculate the similarity with D:

ararat\data\files\N\38\478130\4419430\1\finds\3dbatch\2022\batch\_015\registration\_reso1\_maskthres242\final\_output\piece\_9\_world\_sample0\_3\_mesh.

17