

# UW-MOS

## Seafloor mosaicking from optical data

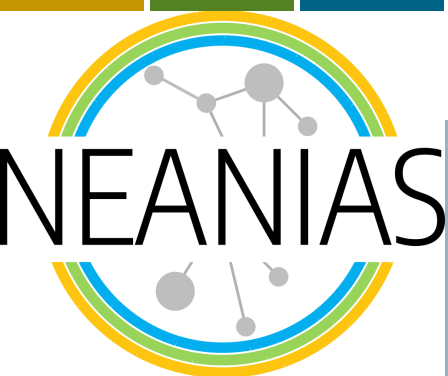
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[www.neanias.eu](http://www.neanias.eu)



Novel EOSC Services for Emerging  
Atmosphere, Underwater & Space  
Challenges

NEANIAS receives funding from  
European Union under Horizon  
2020 Research and Innovation  
Programme under grant  
agreement No. 863448



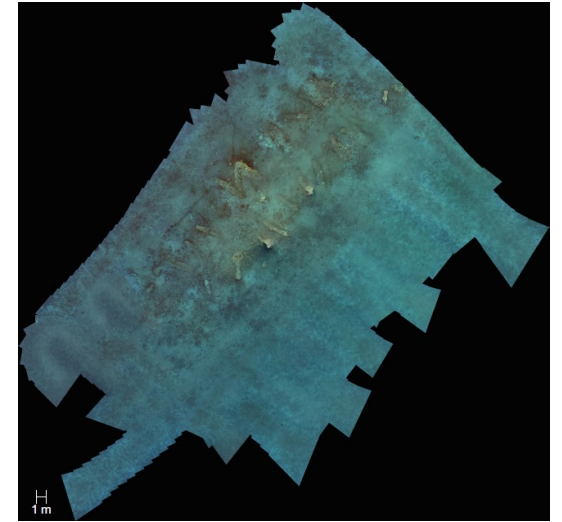
# UW-MOS: Purpose and Technology

## › Purpose:

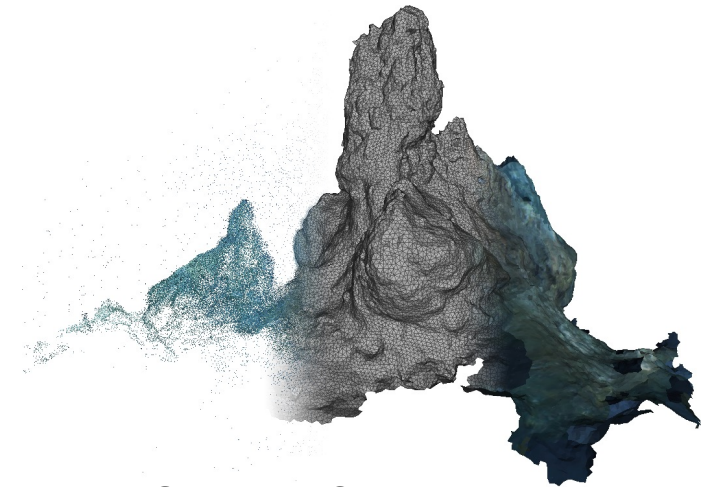
- Create 2D/3D maps from images.
- Input:
  - › Set of images collected during a survey mission.
  - › (optional) Navigation data for georeferencing.
- Output (result type selected by the user):
  - › 2D mosaic: a 2D image of the scene.
  - › 3D mosaic: textured surface triangle mesh.

## › Technology:

- Based on Coronis in-house solutions and some other commonly used open source libraries from the Computer Vision community (OpenCV, OpenMVG, OpenMVS, ...)



Sample 2D mosaic



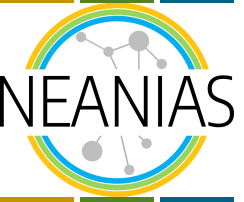
Sample 3D map

# UW-MOS: Current Status (Functionality)


- › UW-MOS provides **six sub-services/tasks**:
  - Camera calibration.
  - Image undistortion.
  - Image enhancement.
  - Image data quality check.
  - 2D image mosaicing.
  - 3D reconstruction.
- › The user can launch **more than a task at the same time**.
- › **Demo data** available for each task, accessible from the web.
- › REST **API** available following the OpenAPI v3.0.2 specification.
- › Complete **documentation**: <https://docs.neanias.eu/projects/u2-service/en/latest/>

# UW-MOS: Current Status (Functionality)


- › That UW-MOS provides six tasks **does not mean you need to run them all** to get the final map.
- › The service is designed to reach a wide audience, regardless of their experience in photogrammetry.
- › Therefore, if you:
  - Have some background in photogrammetry, and you have calibration data for your camera, you can run our *camera calibration task* before trying to run the *2D or 3D mapping tasks*, as results will be more accurate in this case.
  - If you do not have any experience in photogrammetry, and just have a sequence of images observing a scene, you can *go directly to the 2D or 3D mapping tasks*, and we will estimate the camera calibration during the map construction for you.
  - All the other steps (*undistortion, image enhancement, data quality*) are highly recommended, but completely optional!



# UW-MOS: Task Configuration



- Home
- My Tasks
- Calibration
- Undistortion
- Enhancement
- Quality check
- 2D mosaicing
- 3D reconstruction
- Sign out
- Documentation
- API Documentation
- Terms and Conditions
- Privacy Policy



UW-MOS

## Calibrate a camera

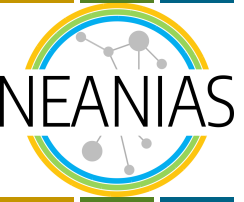
1 INPUT DATA SOURCE    2 INPUT IMAGES    3 TASK-SPECIFIC CONFIGURATION    4 COMMON CONFIG AND SUBMISSION

### INPUT DATA SOURCE

Select the desired source of the input images

- Local storage
- NEANIAS' data sharing service (Nextcloud)**
- Input images of an already-executed task
- Output images of an already-executed task


Next



# UW-MOS: Task Configuration

NEANIAS

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UW-MOS

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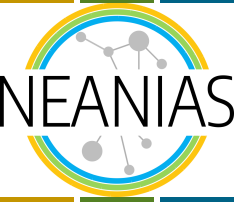
1 INPUT DATA SOURCE   2 INPUT IMAGES   3 TASK-SPECIFIC CONFIGURATION   4 COMMON CONFIG AND SUBMISSION

### INPUT IMAGES


Select the input images

- uw-mos\_calib\_demo\_data
  - user\_images
    - img\_00813.jpg
    - img\_00814.jpg
    - img\_00815.jpg
    - img\_00816.jpg
    - img\_00817.jpg
    - img\_00818.jpg
  - georef\_sample

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# UW-MOS: Task Configuration

UW-MOS

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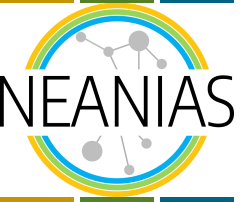
1 INPUT DATA SOURCE    2 INPUT IMAGES    3 TASK-SPECIFIC CONFIGURATION    4 COMMON CONFIG AND SUBMISSION

### TASK-SPECIFIC CONFIGURATION


Choose the options at your will

Option	Value	Description
Pattern type	Chessboard	The type of calibration pattern to use. See the differences between the two options available in the <a href="#">docs</a> .
Pattern width	11	Number of squares in in the pattern in the horizontal direction (i.e., from left to right). For Charuco patterns, take into account the chessboard-like pattern only.
Pattern height	11	Number of squares in in the pattern in the vertical direction (i.e., from top to bottom). For Charuco patterns, take into account the chessboard-like pattern only.
Squares' length	0.1	The lenght of the side of a square in the pattern, in meters.
Markers' length	0.08	The lenght of the side of a marker in the pattern, in meters m (only required/used when the pattern is of <i>charuco</i> type).
Dictionary ID	0	The ID of the Aruco dictionary of markers that was used to create the pattern (only required/used when the pattern is of <i>charuco</i> type).

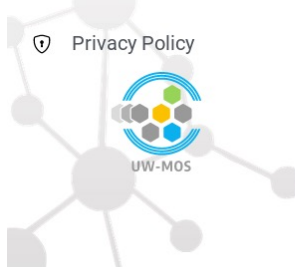
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# UW-MOS: Task Configuration

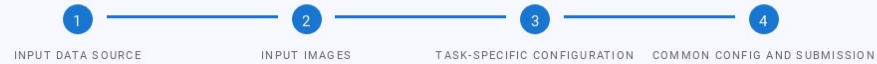


- Home
- My Tasks
- Calibration
- Undistortion
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- 3D reconstruction
- ricardcd@gmail.com
- Sign out
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UW-MOS ricardcd@gmail.com

## Calibrate a camera



### COMMON CONFIGURATION AND SUBMISSION

Finally, fill the following information and submit the task

Give a short **label** to this task, for later reference (50 chars):

You can also provide a longer **description** for this task, if you wish (500 chars):

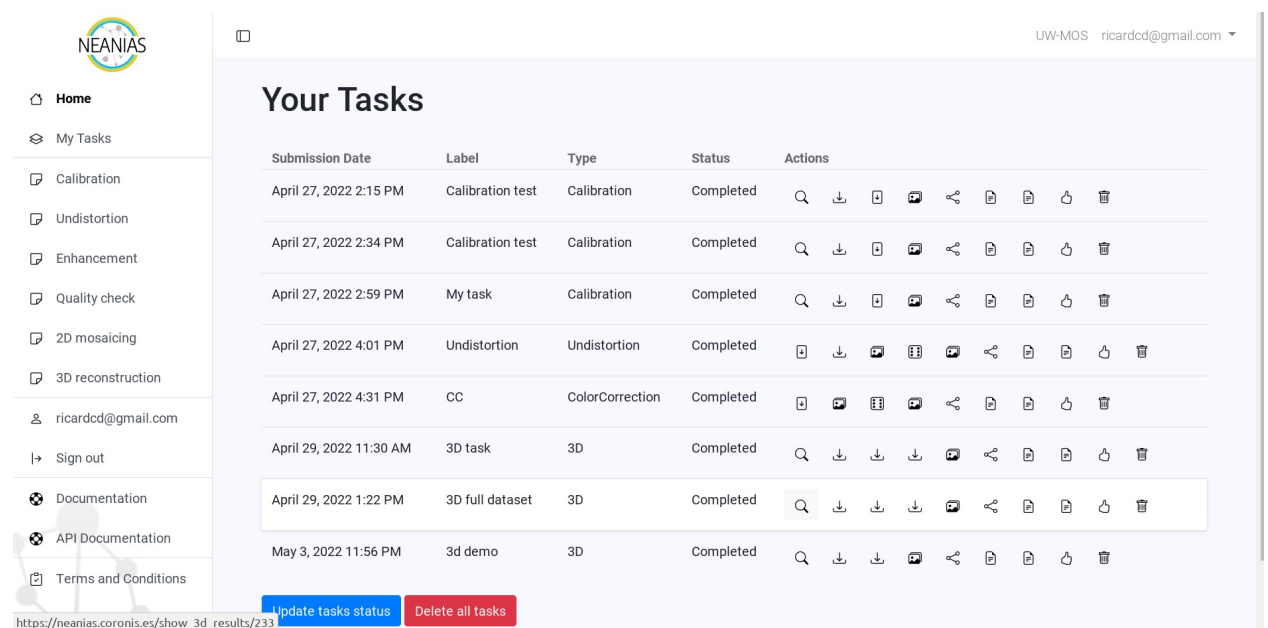
Also, choose the **Kubernetes context** where the task will be executed:

Finally, you can proceed to **submit the task** with the button below:



# UW-MOS: Tasks List

- › View the status of the task (processing, finished, etc.)
- › Several actions available for each task:
  - View and/or Download results in different formats.
  - View the input images, processed ones (undistortion and image enhancement) and input/processed side-by-side.
  - Share results back to the user via the NEANIAS Data Sharing service.
  - Get a report with all the steps executed to obtain the results, for reproducibility.
  - User feedback survey (please fill!)
  - Delete the task



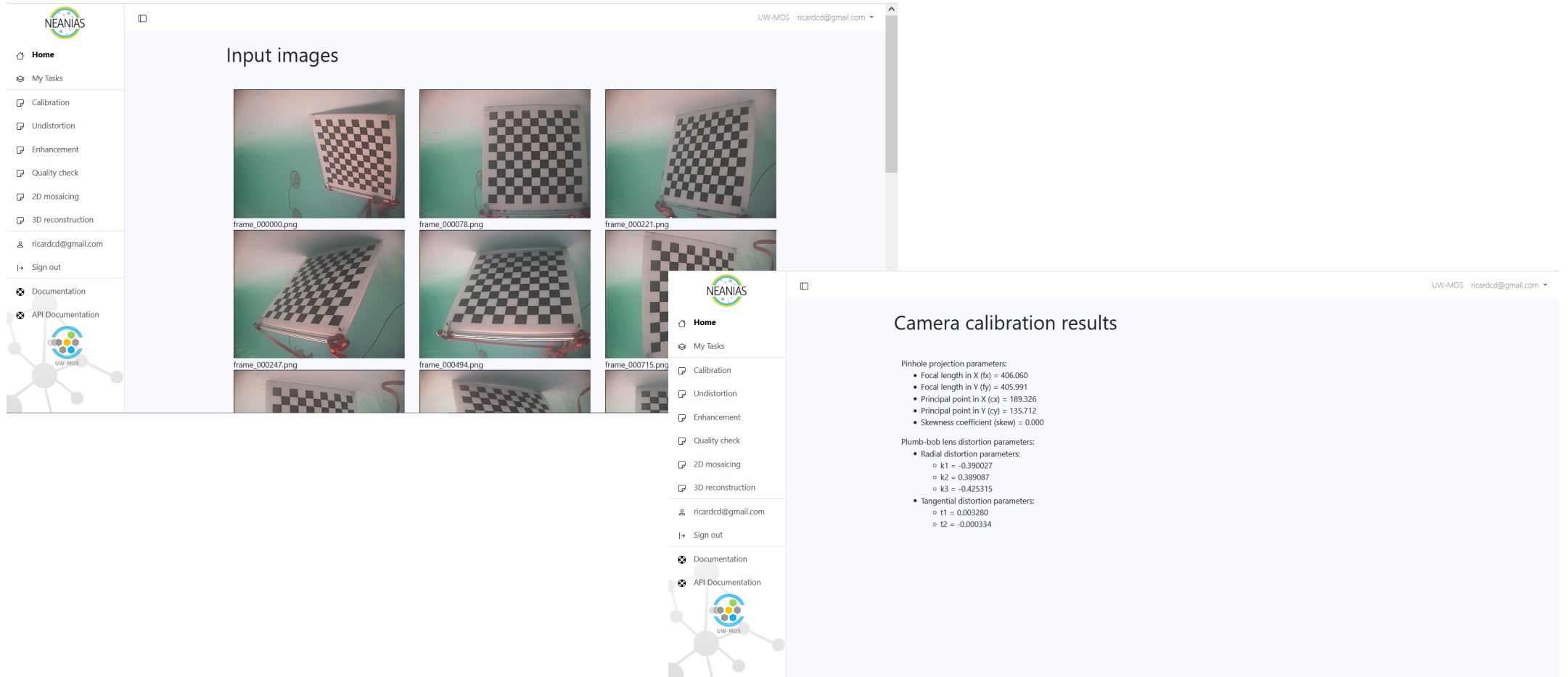
Submission Date	Label	Type	Status	Actions
April 27, 2022 2:15 PM	Calibration test	Calibration	Completed	[Search] [Download] [Print] [Share] [Refresh] [Share] [Share] [Share] [Share]
April 27, 2022 2:34 PM	Calibration test	Calibration	Completed	[Search] [Download] [Print] [Share] [Refresh] [Share] [Share] [Share] [Share]
April 27, 2022 2:59 PM	My task	Calibration	Completed	[Search] [Download] [Print] [Share] [Refresh] [Share] [Share] [Share] [Share]
April 27, 2022 4:01 PM	Undistortion	Undistortion	Completed	[Download] [Download] [Print] [Share] [Refresh] [Share] [Share] [Share] [Share]
April 27, 2022 4:31 PM	CC	ColorCorrection	Completed	[Print] [Print] [Print] [Share] [Refresh] [Share] [Share] [Share] [Share]
April 29, 2022 11:30 AM	3D task	3D	Completed	[Search] [Download] [Download] [Download] [Share] [Share] [Share] [Share] [Share]
April 29, 2022 1:22 PM	3D full dataset	3D	Completed	[Search] [Download] [Download] [Download] [Share] [Share] [Share] [Share] [Share]
May 3, 2022 11:56 PM	3d demo	3D	Completed	[Search] [Download] [Download] [Print] [Share] [Refresh] [Share] [Share] [Share]

Update tasks status Delete all tasks

https://neanias.coronis.es/show\_3d\_results/233

# UW-MOS: Camera Calibration Task

- › Obtains the intrinsic parameters of a camera given a set of views of a known pattern:



The screenshot displays the UW-MOS web application interface. On the left is a navigation sidebar with options: Home, My Tasks, Calibration, Undistortion, Enhancement, Quality check, 2D mosaicing, 3D reconstruction, and Documentation. The main content area is titled "Input images" and shows a 3x3 grid of checkerboard calibration images with filenames like "frame\_000000.png". A modal window titled "Camera calibration results" is open, displaying the following parameters:

**Pinhole projection parameters:**

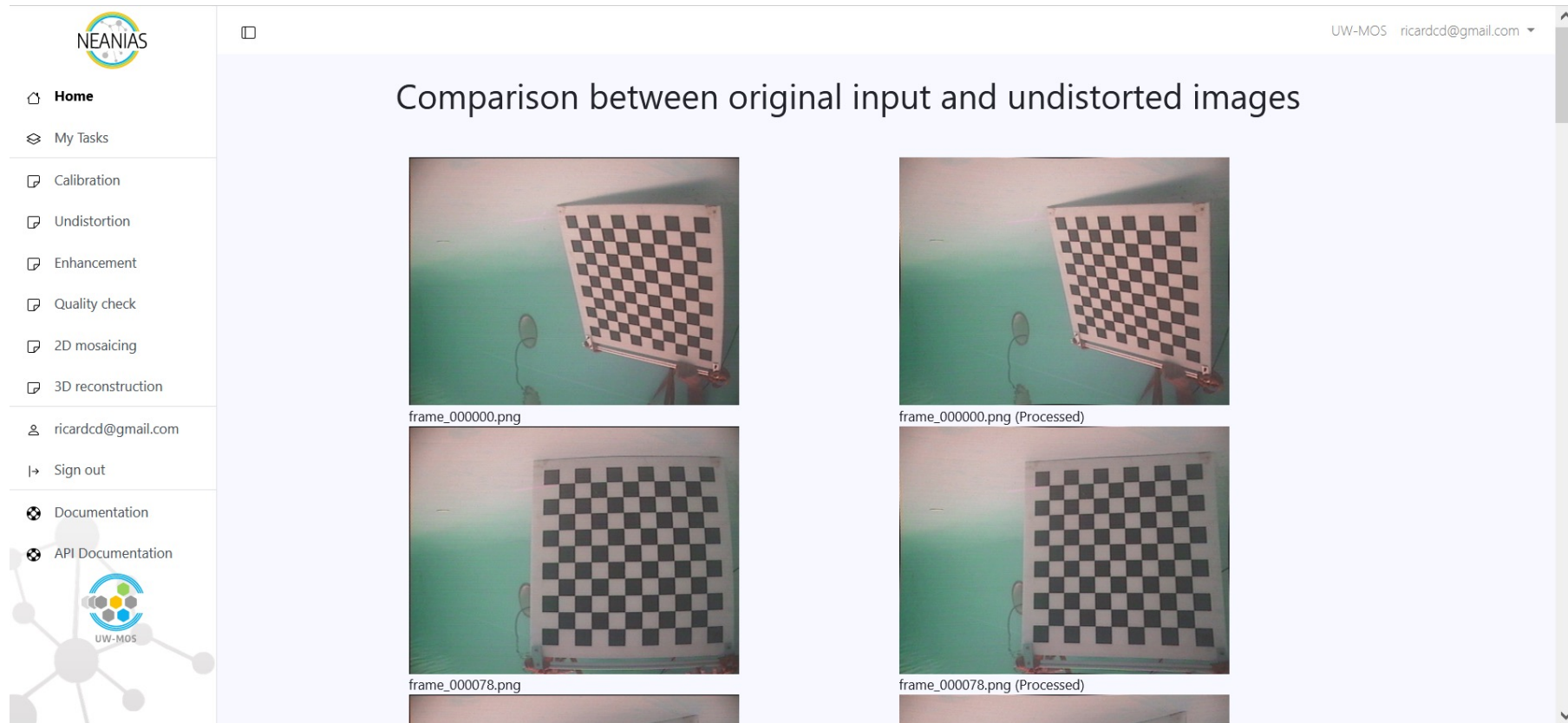
- Focal length in X ( $f_x$ ) = 406.060
- Focal length in Y ( $f_y$ ) = 405.991
- Principal point in X ( $c_x$ ) = 189.326
- Principal point in Y ( $c_y$ ) = 135.712
- Skewness coefficient (skew) = 0.000

**Plumb-bob lens distortion parameters:**

- Radial distortion parameters:
  - $k_1$  = -0.390027
  - $k_2$  = 0.389087
  - $k_3$  = -0.425315
- Tangential distortion parameters:
  - $t_1$  = 0.003280
  - $t_2$  = -0.000334

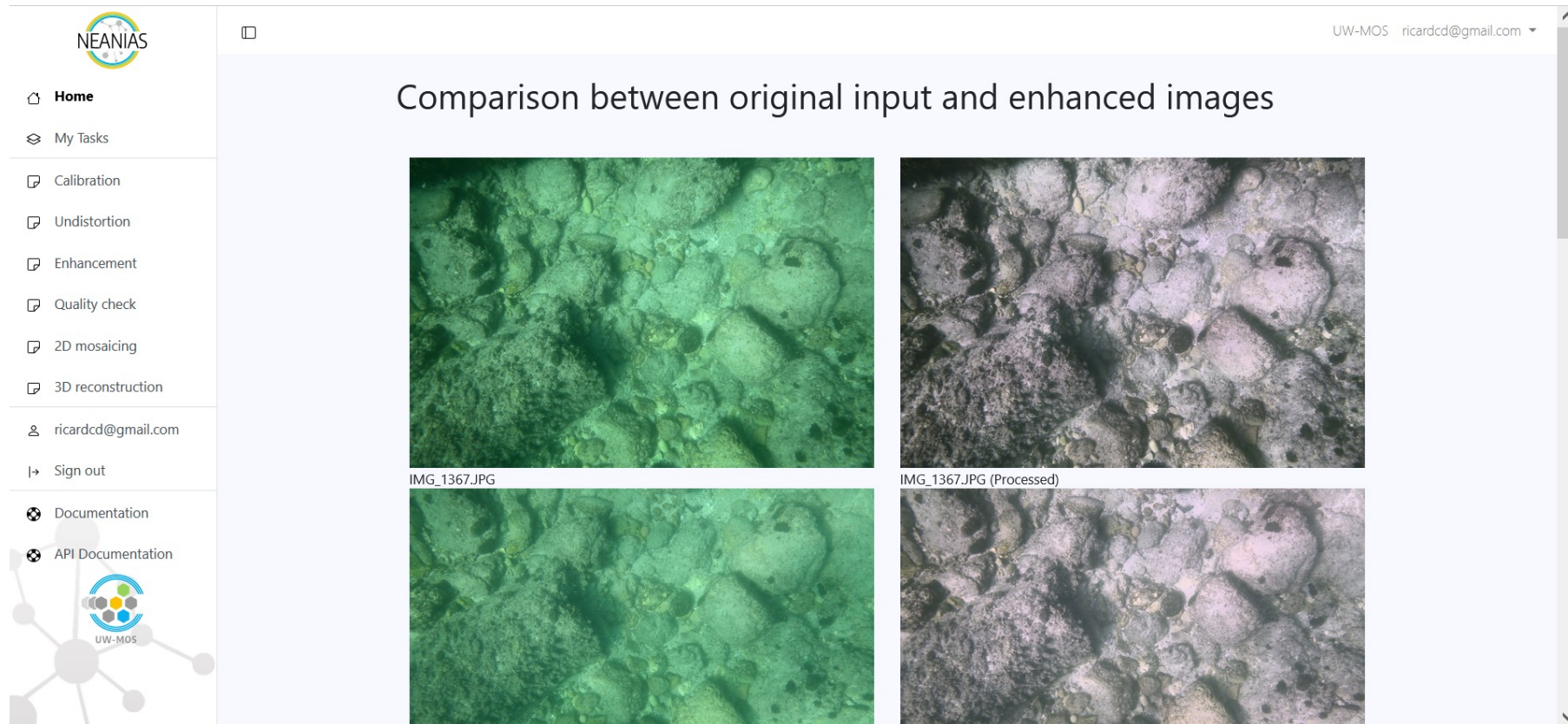
# UW-MOS: Image Undistortion Task

- › Given the camera parameters obtained in the previous task, removes the distortions of the image caused by the camera lenses:



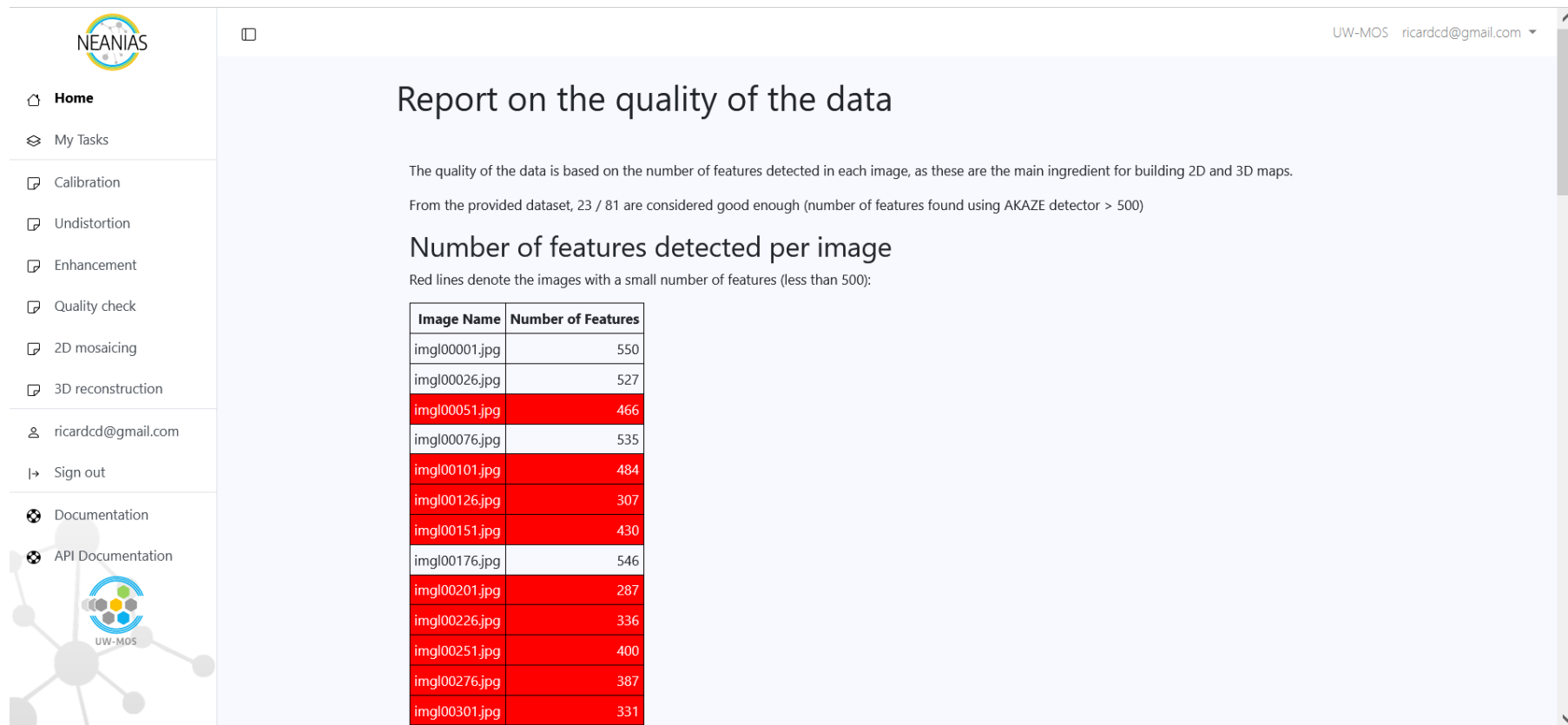
# UW-MOS: Image Enhancement Task

- › Since underwater images suffer from lack of contrast and color shifting, we provide an image enhancement method suited for underwater data:



# UW-MOS: Data Quality Check Task

- › Perform some quick checks to test the suitability of a set of images to be used as input of the 2D or 3D mapping pipelines:



The screenshot shows the UW-MOS web application interface. On the left is a navigation sidebar with the NEANIAS logo at the top, followed by menu items: Home, My Tasks, Calibration, Undistortion, Enhancement, Quality check, 2D mosaicing, and 3D reconstruction. Below these are user information (ricardcd@gmail.com) and sign-out options, and finally documentation links. The main content area is titled "Report on the quality of the data" and includes an explanatory paragraph about feature detection. Below the text is a table titled "Number of features detected per image" with a red header. The table lists 15 image files and their corresponding feature counts. The first two rows are white, and the remaining 13 rows are highlighted in red, indicating a low feature count.

**Report on the quality of the data**

The quality of the data is based on the number of features detected in each image, as these are the main ingredient for building 2D and 3D maps.

From the provided dataset, 23 / 81 are considered good enough (number of features found using AKAZE detector > 500)

**Number of features detected per image**

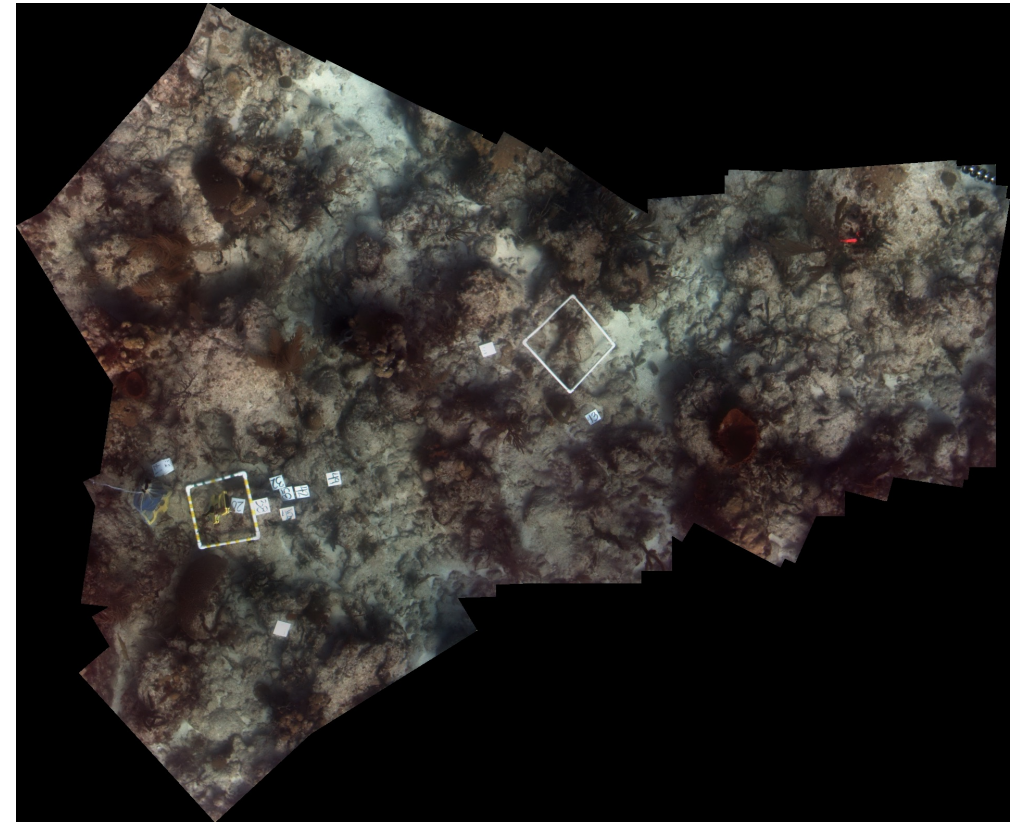
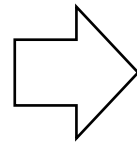
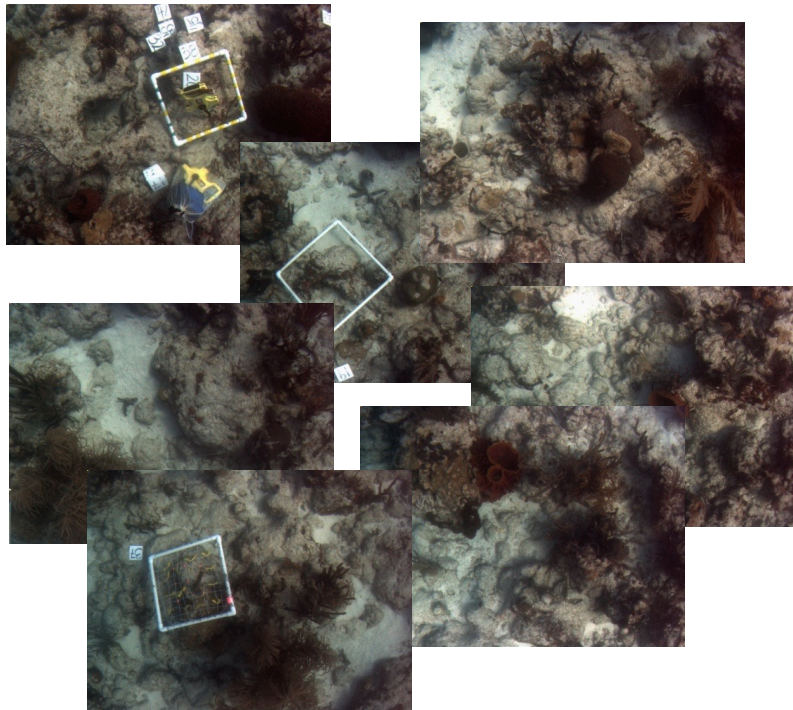
Red lines denote the images with a small number of features (less than 500):

Image Name	Number of Features
imgl00001.jpg	550
imgl00026.jpg	527
imgl00051.jpg	466
imgl00076.jpg	535
imgl00101.jpg	484
imgl00126.jpg	307
imgl00151.jpg	430
imgl00176.jpg	546
imgl00201.jpg	287
imgl00226.jpg	336
imgl00251.jpg	400
imgl00276.jpg	387
imgl00301.jpg	331



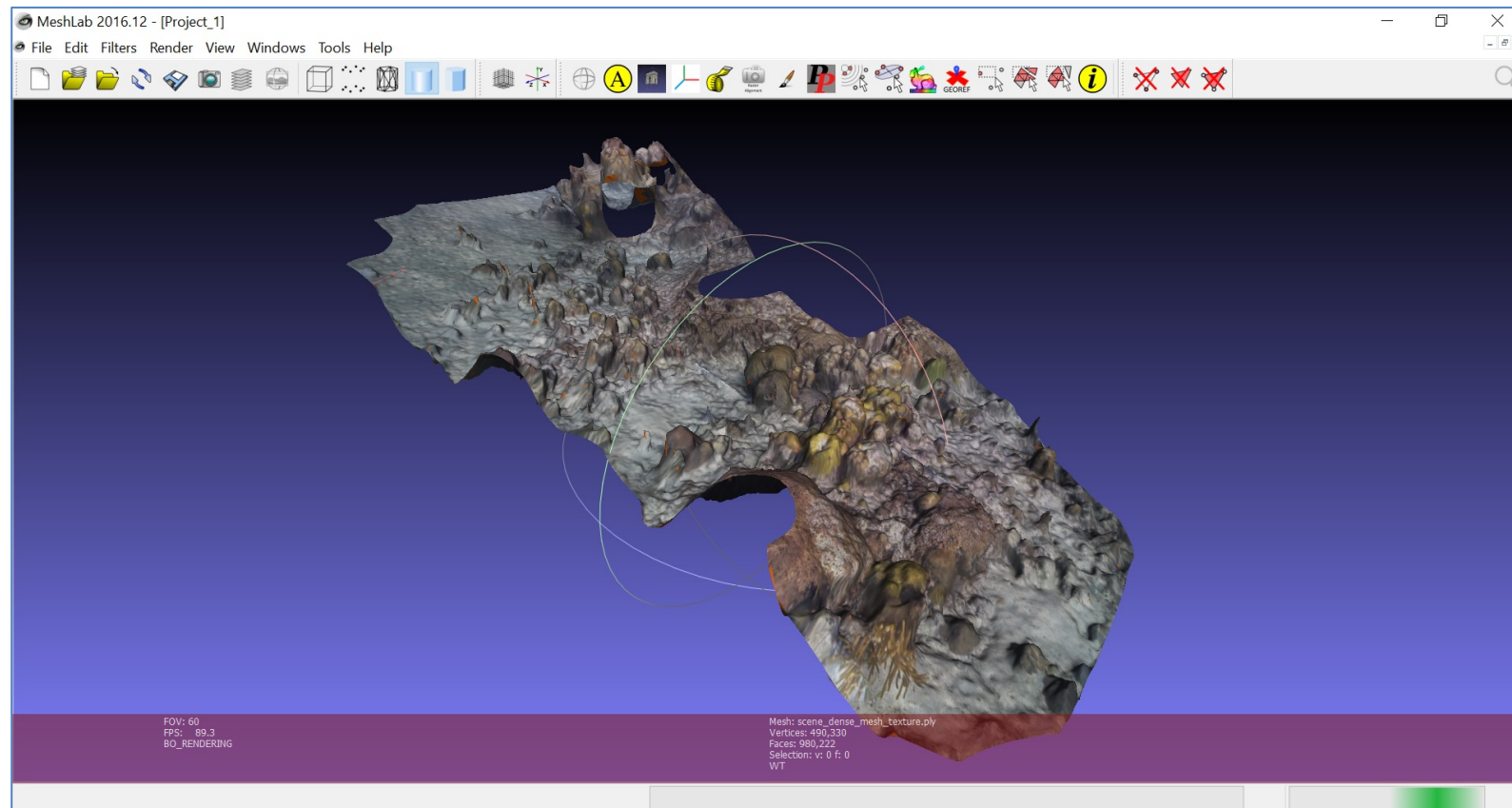
# UW-MOS: 2D Mosaicing Task

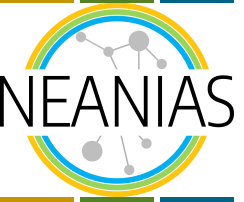
- › Creates a 2D mosaic from a set of images (calibrated or not), the result is a single image composite of the input:



# UW-MOS: 3D Reconstruction Task

- › Computes a 3D reconstruction of the scene, the result is a textured surface triangle mesh, downloadable in formats amenable to web/desktop 3D viewers
- › If georeferencing data is provided per image, the result is a georeferenced map.



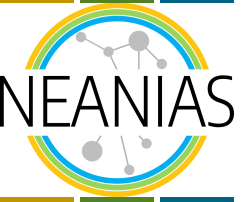


# UW-MOS: Online 3D Viewer

› Geo-referenced online 3D viewer also provided:

A screenshot of the NEANIAS online 3D viewer interface. The interface is split into a left sidebar and a main viewing area. The sidebar on the left contains the NEANIAS logo at the top, followed by a list of menu items: Home, My Tasks, Calibration, Undistortion, Enhancement, Quality check, 2D mosaicing, 3D reconstruction, a user profile icon, Sign out, Documentation, and API Documentation. The main viewing area shows a 3D model of the Earth centered on Africa, set against a black starry background. In the top right corner of the viewer, there are icons for Home, 3D, a globe, and a question mark. In the bottom left corner, there is a circular control panel with a play button, a pause button, and a stop button, along with text indicating '1x Sep 2 2022 05:27:05 UTC'. At the bottom of the viewer, there is a timeline with the Cesium ion logo and 'Data attribution' text, showing time markers from 'Sep 2 2022 08:00:00 UTC' to 'Sep 3 2022 04:00:00 UTC'. A vertical scrollbar is visible on the right side of the viewer.





# UW-MOS: Online 3D Viewer

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A screenshot of the NEANIAS online 3D viewer interface. On the left is a navigation sidebar with the NEANIAS logo at the top, followed by menu items: Home, My Tasks, Calibration, Undistortion, Enhancement, Quality check, 2D mosaicing, 3D reconstruction, a user profile icon, Sign out, Documentation, and API Documentation. The main area displays a 3D reconstruction of a rock specimen, rendered in shades of blue and cyan. The interface includes a settings gear icon in the top left, a home icon, a 3D view toggle, and a help icon in the top right. At the bottom, there is a playback control overlay showing '1x' speed, 'Sep 2 2022 05:24:14 UTC', and a timeline with markers for 'Sep 2 2022 08:00:00 UTC', 'Sep 2 2022 12:00:00 UTC', 'Sep 2 2022 16:00:00 UTC', 'Sep 2 2022 20:00:00 UTC', 'Sep 3 2022 00:00:00 UTC', and 'Sep 3 2022 04:00:00 UTC'. The 'CESIUM ion' logo and 'Data attribution' text are also visible at the bottom.

# UW-MOS: Summary

- › Online photogrammetry service.
- › Provides 2D and 3D mapping tasks, among other optional tasks that help improving the results.
- › The user can run different tasks at the same time, and inspect the results online or download them in various formats.
- › Adapts to the experience of the user:
  - Specific photogrammetry tasks, with several parameters to tune.
  - However, an inexperienced user can run any task with no prior information other than the images and get a nice result.

# UW-MOS

## Seafloor mosaicking from optical data

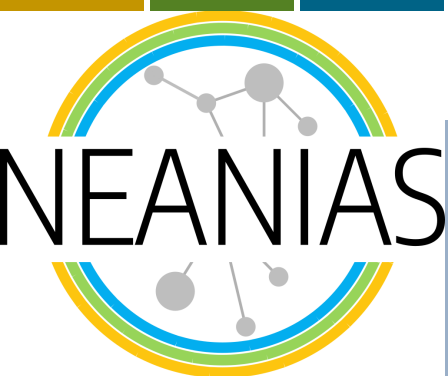
Ricard Campos ([ricard.campos@coronis.es](mailto:ricard.campos@coronis.es))

Rafael Garcia ([rafael.garcia@udg.edu](mailto:rafael.garcia@udg.edu))

Josep Quintana ([josep.quintana@coronis.es](mailto:josep.quintana@coronis.es))



[www.neanias.eu](http://www.neanias.eu)



Novel EOSC Services for Emerging  
Atmosphere, Underwater & Space  
Challenges

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