

# How to make animations of Jupiter from amateur images in 6 easy steps

by

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# Foreword

In December of 2013 I started a project that had grown and taken hold on me for years. Would it be possible to animate our own backyard telescopic images of Jupiter, making them completely immersive and showing the evolution of Jupiters storm systems for a continuous period of more than 3 month?

I had a very vague idea of how this could be done but as a photographer and digital artist I am used to finding solutions to whatever imaging problem that might arise, relying mostly on Photoshop, a software I have been using since the first versions in the early 1990-ies.

Had I been more lucid about the problems I would encounter during this project, it would probably just have remained a dream.

I spent 6 month and thousands of hours on the project that I named "Voyager-3 Project", making a parallel to the iconic probes of the 1970-ies that are still in operation and now transmitting from the interstellar space.

In 2015 I made a short follow up animation showing the proper rotation of the GRS. In order to have pictures taken more frequently, we extended the cooperation to our Australian and Dutch friends.

And finally in 2016 I got into the Mission Juno Pro-Am collaboration thanks to Glenn Orton and decided to do a full scale animation using almost 1,000 images taken in 2015 by 90 skilled planetary photographers from all around the world. One full year and thousands of hours of hard labour later, I released the a new video called "A journey to Jupiter".

These 3 productions were well received by the amateur and professional astronomical communities but they involved so much hard labour and were too time consuming to be used on a regular basis in creating animations.

This last year, I have tried to streamline the workflow and looked for techniques and shortcuts that would enable us to make animations of the same quality but in a fraction of the time and that was the aim of my presentation at Europlanet 2018 in London.

For these animation projects to be successfull, there are some guidelines that should be followed and we need to be consequent in every step in order to get a correct and even result.

With almost 100 photographers involved, there are almost as many variations to the look of the images they produce. Some are of course of very high quality in every respect while others may be too dark or too bright or even overexposed in the highlights, with hues ranging through all the colors of the spectrum. These images will simply not merge seamlessly into a smooth animation so one of the single tasks that has been the most time consuming in the projects mentioned above was to correct the 1,000 images to a common standard in respect of color, contrast, and sharpness.

I hope that we can setup a network and let the photographers do the processing and the Winjupos mapping of their own images to a common standard before uploading them to a database that we will set up in the near future.

This would be the single biggest benefit allowing any of us in a near future to do animations on a regular basis. And it will only take minutes or hours, not weeks or month.

Besides the beauty of seeing the cloud belts of Jupiter swirl and spin, I'm sure it will prove to be a new and valuable tool for analysis and to understand the evolution of the storm systems.

# Step 1 - Image acquisition and preprocessing

Should North be presented up or down? This is a topic of much discussion but I have opted for South up and the planet presented as horizontally as possible.

Acquire the files only as plain RGB , no L-RGB, IR-RGB or IRGB.

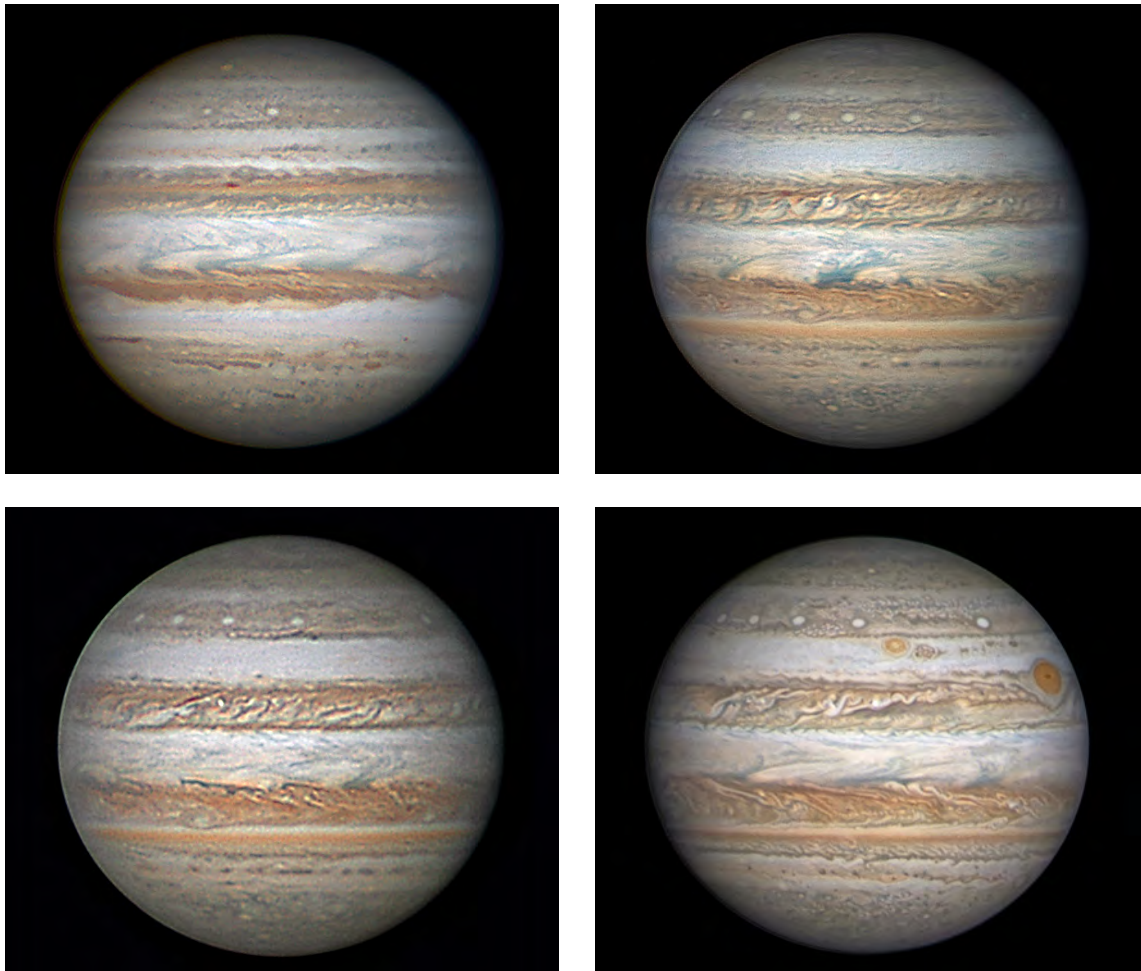
You may derotate them over a period but this is not absolutely necessary. For an animation project it might be preferable to make separate images of the beginning and end of a session that will result in a better total coverage.

Try to take images also at odd hours when not everybody else is out photographing the same side of Jupiter. This will be helpful in increasing the coverage of the maps. Don't throw away the less than perfect images, they are needed for the continuity and will integrate seamlessly with the better ones.

Don't crop out the moons from your images as they help to make a more precise mapping in Winjupos. They will be removed later from the Winjupos projections before being stacked and stitched.

Stack your images and process them to a normalised standard, see the examples bellow. Make sure to keep a good histogram reading so no details are burnt out and keep the limbs sufficiently bright so they can be easily identified. If they are very dark, it may result in mapping errors in Winjupos.

Name the files in the format jYYYY-MM-DD\_HH-MM-SS\_RGB\_xxx (xxx being your initials with 2 or 3 letters). In this way they will be correctly named for Winjupos and displayed in chronological order. The timing is measured as the middle of the captured sequence.



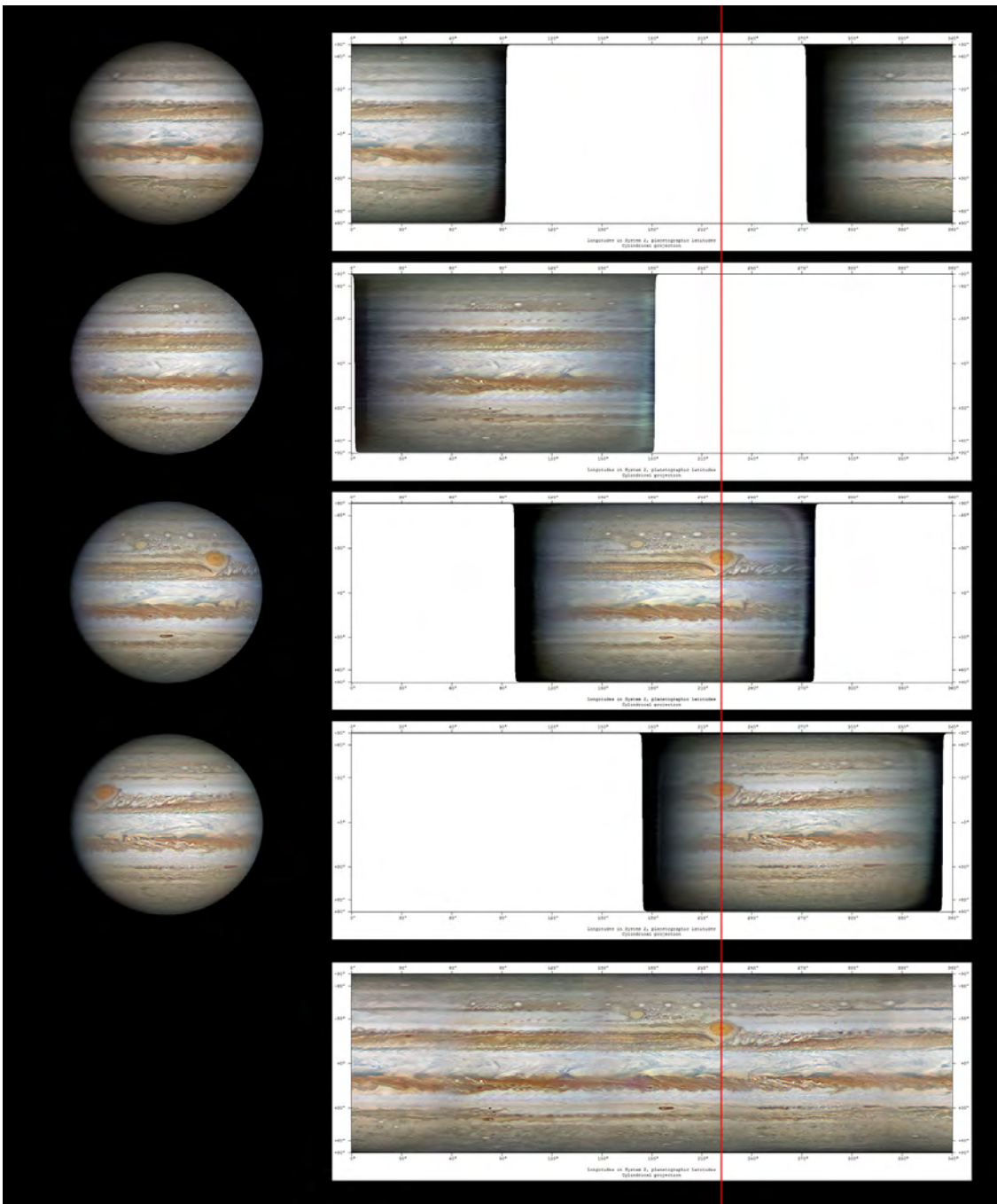
*4 images taken by Anthony Wesley, Chistopher Go, Clyde Foster and Damian Peach that are good examples of images that will work very well when combined and merged into a single map.*

## Step 2 - Mapping in Winjupos

You are probably more knowledgeable about the mapping in Winjupos than I am as I only work on a Mac and have received some helping hands when it comes to this stage, so I will not give any advice about how to perform the mappings, just some useful guidelines.

Map the images in Winjupos as Longitudes in System 2, planetographic latitudes, Cylindrical projections. Make the image area itself 1800 x 536 pixels.

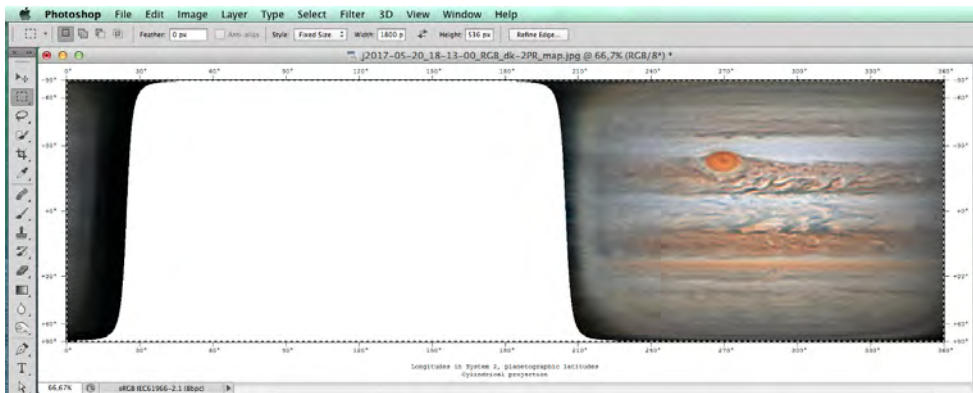
This is a good scale as 1800 pixels correspond to the full 360° coverage meaning that 5 pixels correspond to 1° making measurements in the Photoshop files very easy to perform.



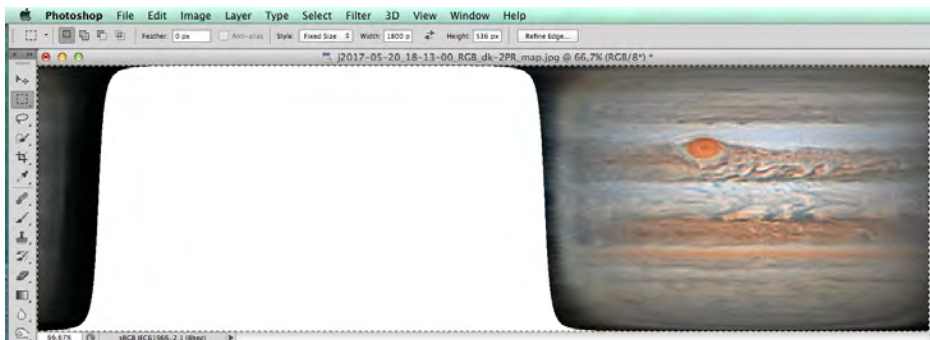
*The 4 images on the left by Damian Peach and Tiziano Olivetti are taken approximately 2,5 hours apart. To the right, the corresponding cylindrical projections represent a translation along the x-axis of longitudes. The red line illustrates how the GRS remains at the same longitude when the images are rendered in Winjupos. The figure at the bottom represents a complete map corresponding to the addition of the 4 projections above.*

## Step 3 - Preparing the maps for stacking and stitching in Photoshop

Open the maps in Photoshop and crop them to the exact image area of 1800 x 536 pixels using the Rectangular Marquee Tool, Style: Fixed Size, With:1800 pix, Height: 536 pix.



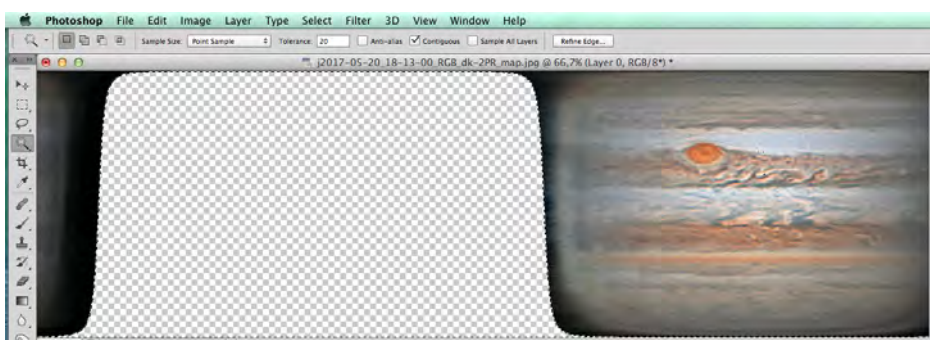
Go to Image > Crop in the menu to only keep the image area.



Select the Magic Wand Tool with the settings Tolerance: 20 (works most of the time), uncheck Anti-alias, and check Continuous. Click anywhere in the white area that will then become selected.

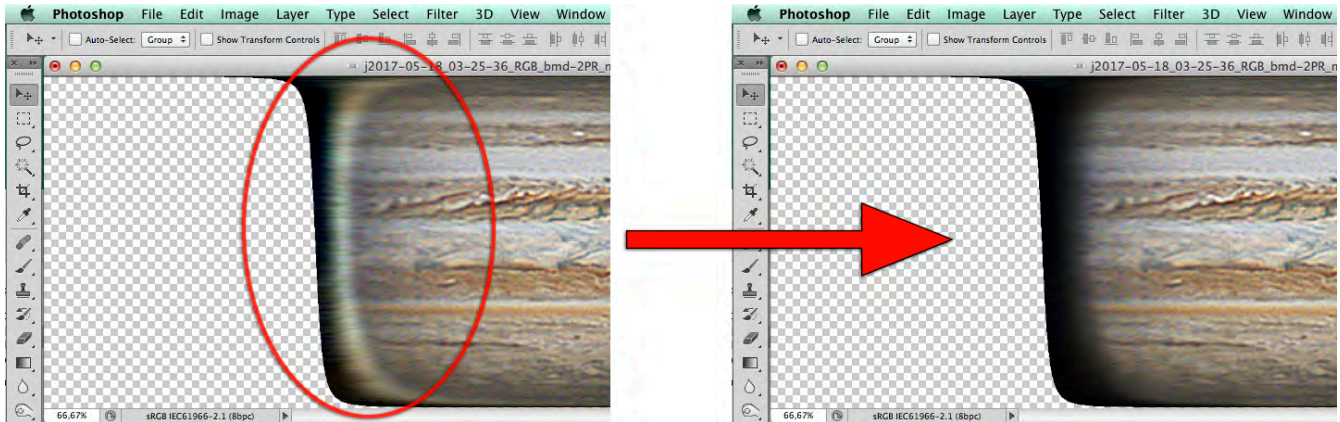


The layer is locked by default. Double click on it in the Layer Palette to unlock it and make it a floating layer. Press the Delete/Backspace key on the keyboard to remove the selected white area and make it transparent. Save the images to a new folder in a format that accepts transparency like PSD, TIFF or PNG.



## Step 4 - Stacking and stitching

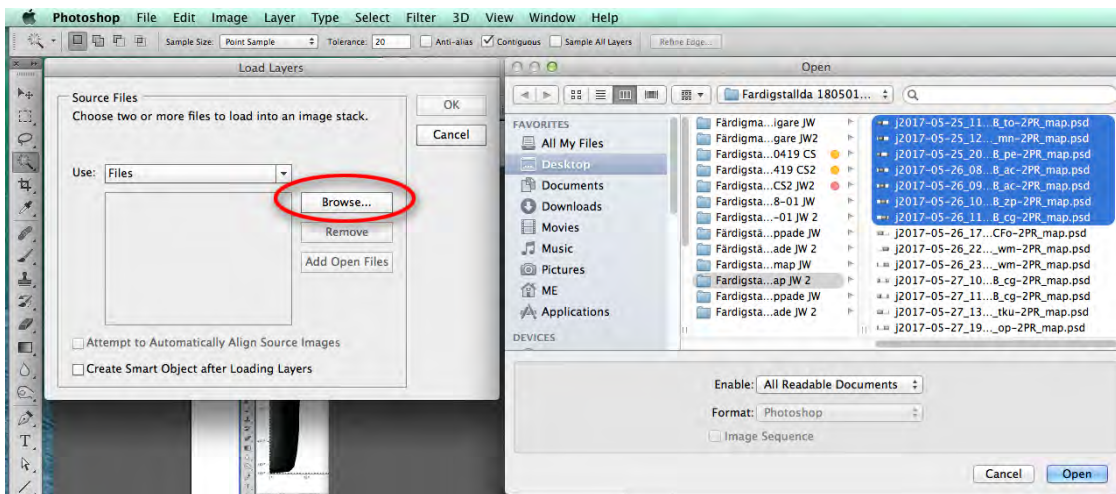
You should now have a folder with all your maps that are almost ready to be stacked and stitched together. An important last step is to darken any artifact that can appear on the limb. They generally result from camera flaws or sharpening and become overly broad by the stretching in the Winjupos mapping.



We are now ready for the stacking. It is important to proceed in a chronological order from the oldest images to the most recent ones.

Use just enough files to get a good overlap and that will cover the whole 360° surface. At least 4 or 5 will be needed but sometimes more depending on the quality of the images.

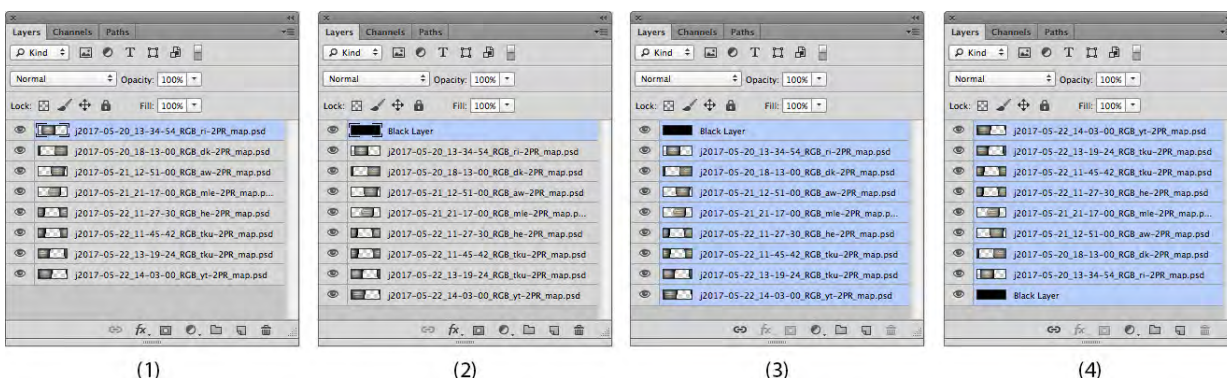
The best way to do this is to go to Files > Scripts > Load files into Stacks, click on Browse and select the files you want to open.



They will automatically appear as layers in a new document and retain their original name (1).

Put a black layer at the top of the layer stack (2).

Select all the layers (3). Go to Layers > Arrange > Reverse. This will reverse the order so the oldest map is at the bottom and the most recent is at the top of the stack (4).



(1)

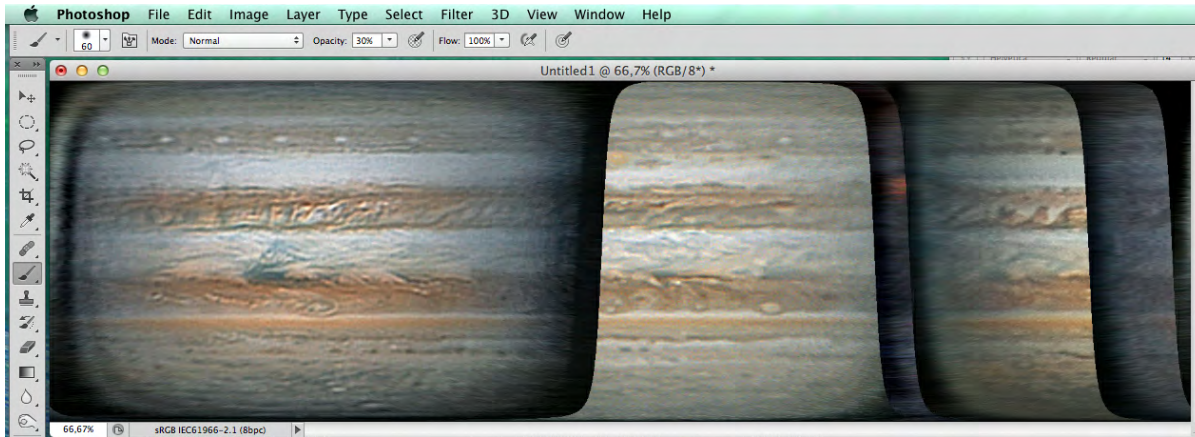
(2)

(3)

(4)

## Step 4 - Stacking and stitching - continued

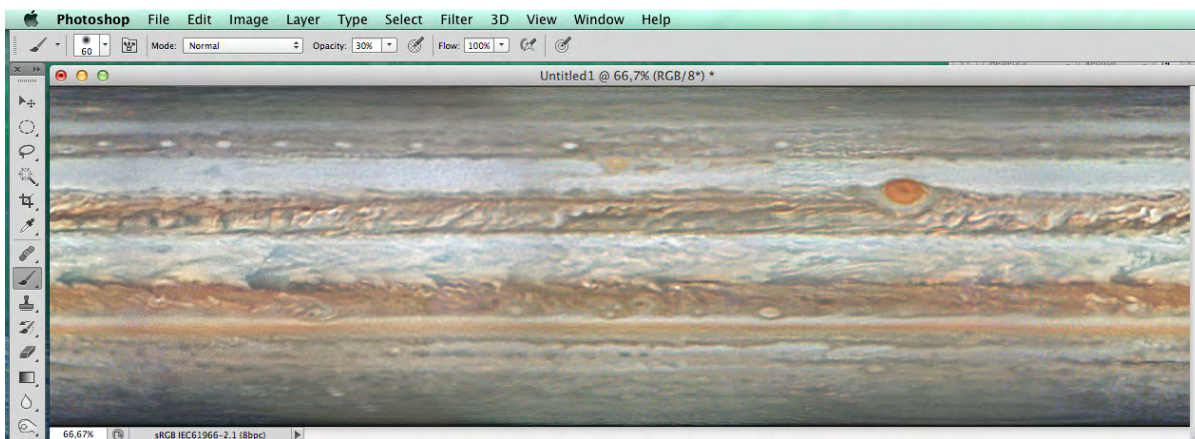
The image bellow shows what your map should look like at this stage.  
You can blink between consecutive layers to make sure that they are well registered.  
If the mapping was done correctly in Winjupos there should be no problem.



Select all the image layers in the Layer Palette and change the blending mode to Lighten



The images will automatically blend into a an almost perfect 360° map.



You should flatten the layers and save the map into a new folder. Proceed to the next set of images to stack. Ideally the mean time between 2 finished maps should be no more than 2 to 4 earth days corresponding to 5-10 revolutions of Jupiter.  
You can bring all the finished maps into a video editor to make an animation or you can make an animated gif from within Photoshop.

Many of the steps described untill now can be scripted into Photoshop Actions and performed automatically.

## Step 5 - Polar Projections

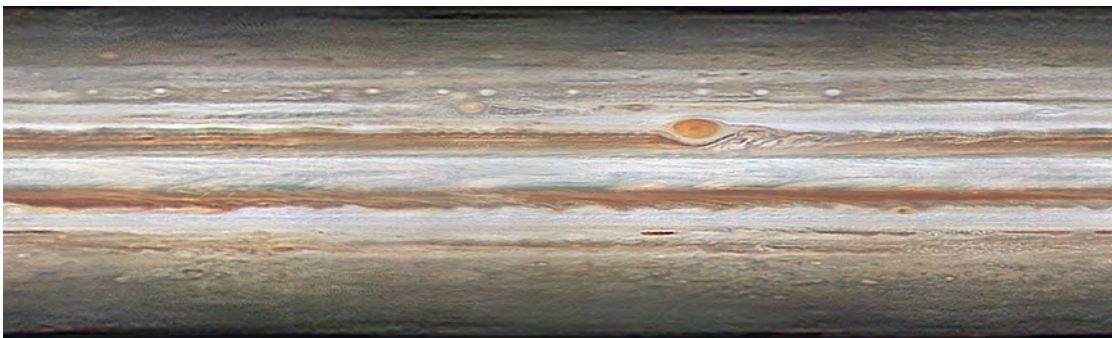
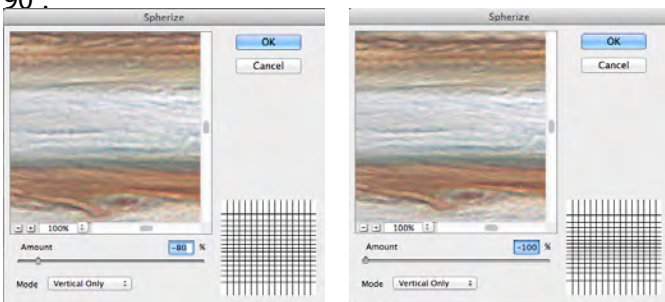
South Polar projection.

Transforming a cylindrical map into a polar projection is extremely easy in Photoshop, just follow the steps bellow: Open a finished 360° map and upscale it to 200 % so it becomes 3600 x 1072 pixels in size.

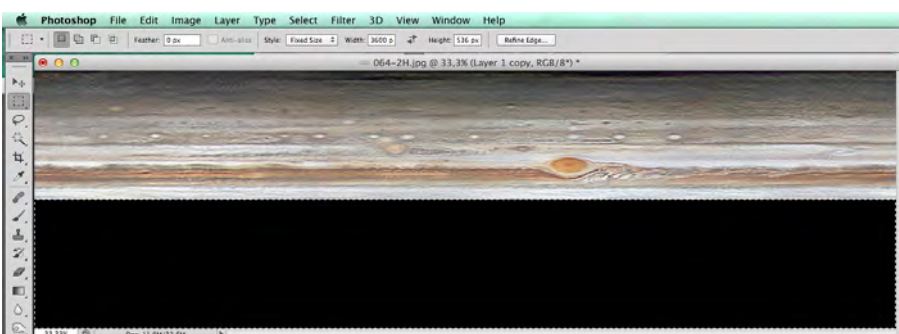


Go to the Filter Menu and choose Distort > Spherize and then Mode: Vertical Only

Here you have got several choices. Use Amount -80 if you just want the render the polar view just to be aesthetical. If you want to be able to perform measurements then you should choose Amount -100 as it will render the latitudes as equidistant circles. For example, the distance between 20° and 30° will be the same as between 80° and 90°.



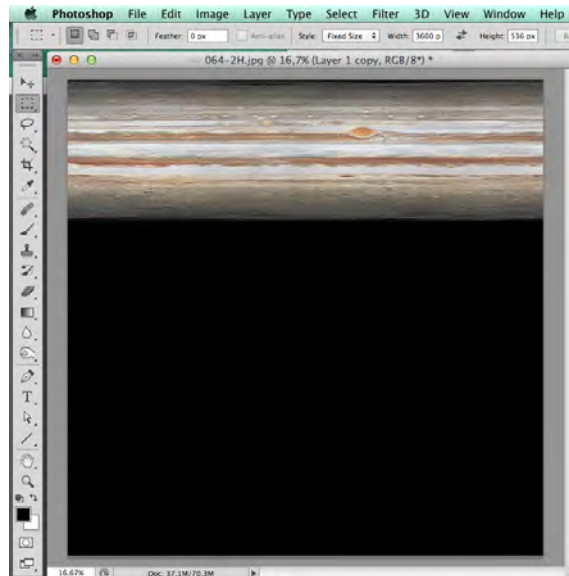
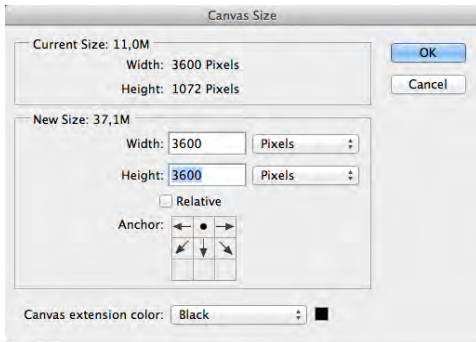
If you use the above map, the polar projection will display from Pole to Pole. I am quite found of this rendering as it still lets you follow all the cloudbelts around the whole planet but it might not be considered acceptable for some people. For a rendering from Pole to Equator, just fill the lower half of the map with black and proceed the same way.



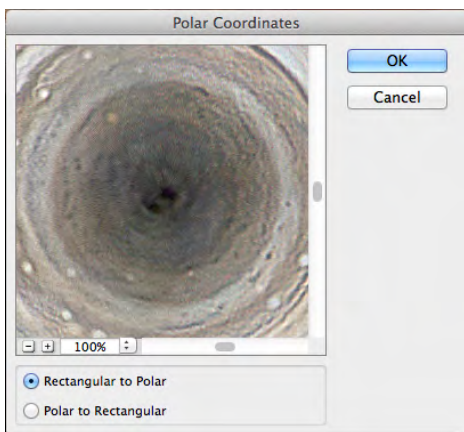


## Step 5 - Polar Projections - Continued

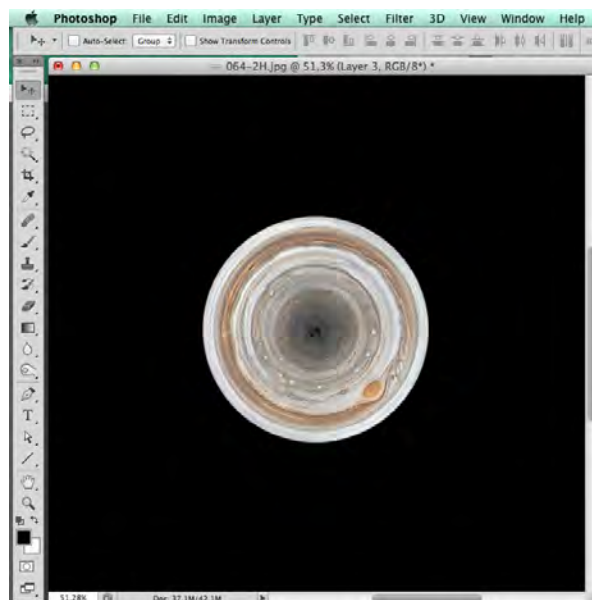
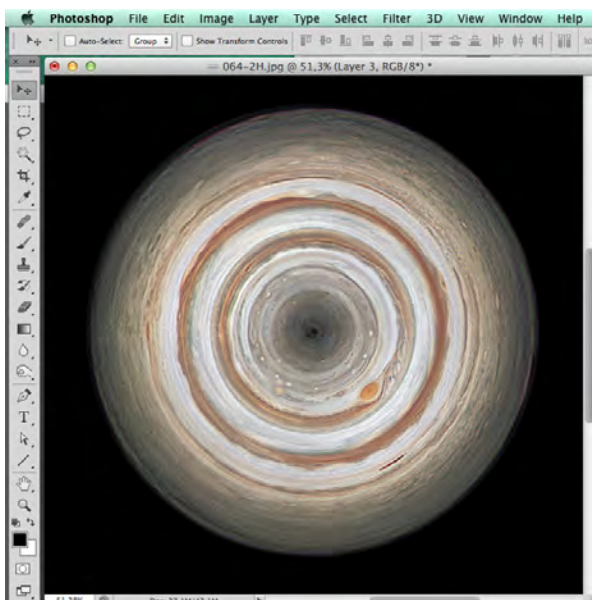
Extend the Canvas size downwards with black into a square of 3600 x 3600 pixels by choosing Image > Canvas Size in the Menu



Go to Filter > Distort > Polar Coordinates and choose Rectangular to Polar.



Crop the image to a nice working size, for example 1200 x 1200 pixels, as there is a lot of black surrounding the image. If you have chosen to display from Pole to Equator, the projection will look like the one below to the right.



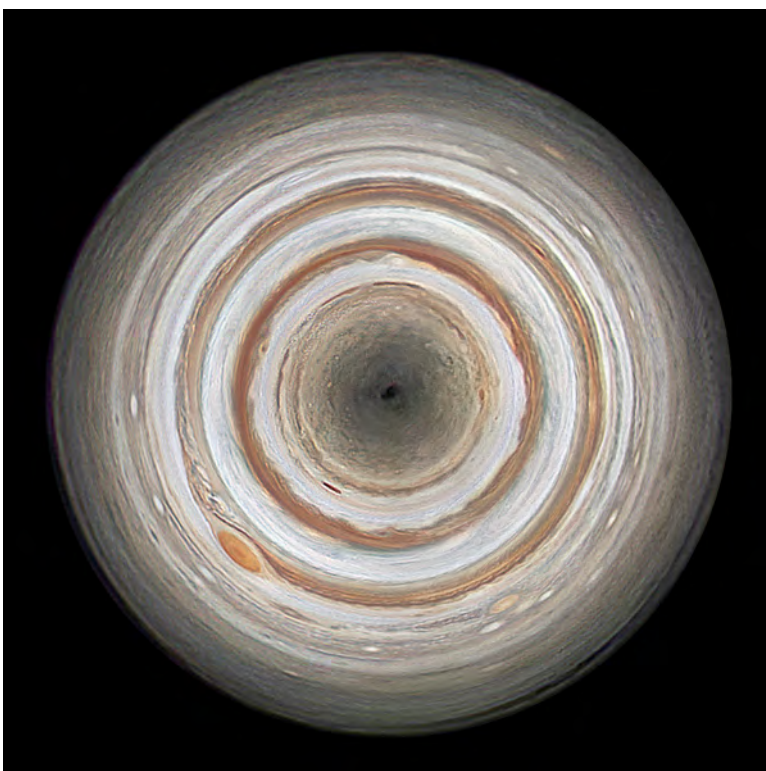
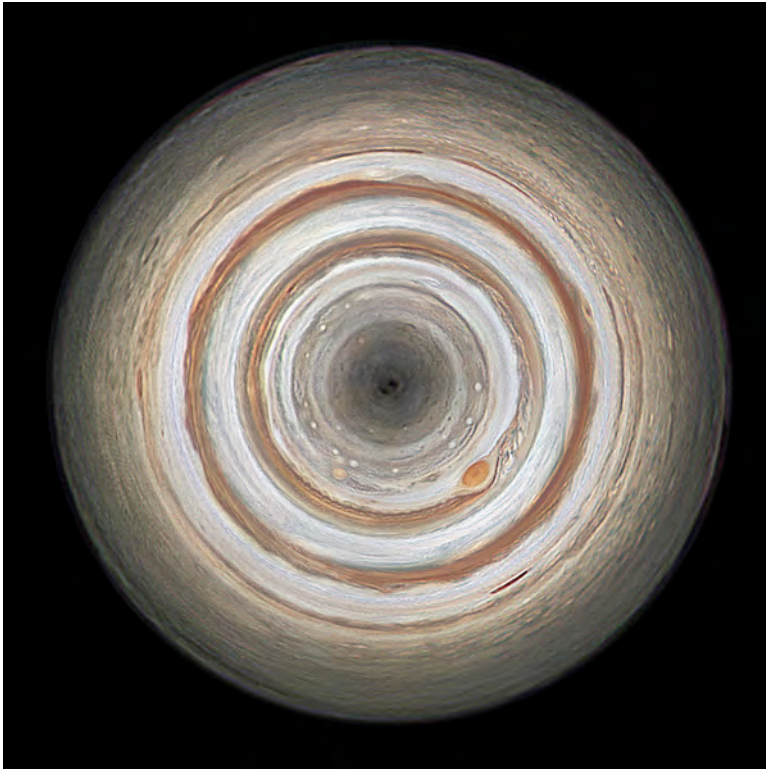
## Step 5 - Polar Projections - Continued

North Polar projection.

To make a North Polar Projection, you just start by rotating the initial map by 180° and you proceed exactly the same way as for the South Polar Projection.

All these steps can easily be put into a Photoshop Action and it can transform a folder with hundreds of maps in a matter of a few minutes.

Bellow are the results of the South Polar Projection and the North Polar Projection, from Pole to Pole.



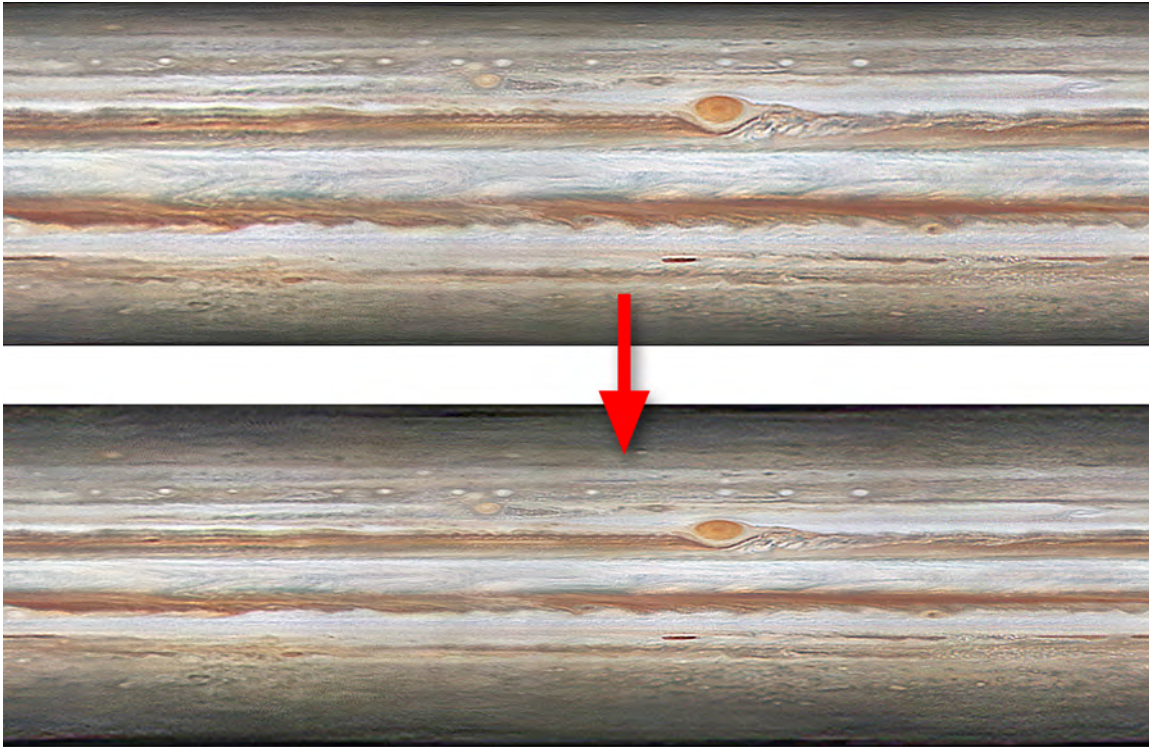
## Step 6 - Beyond the Equatorial and Polar Maps

If you carefully follow the steps described in this paper, anybody should be able to produce high quality animated equatorial and polar maps of Jupiter in a relatively short time.

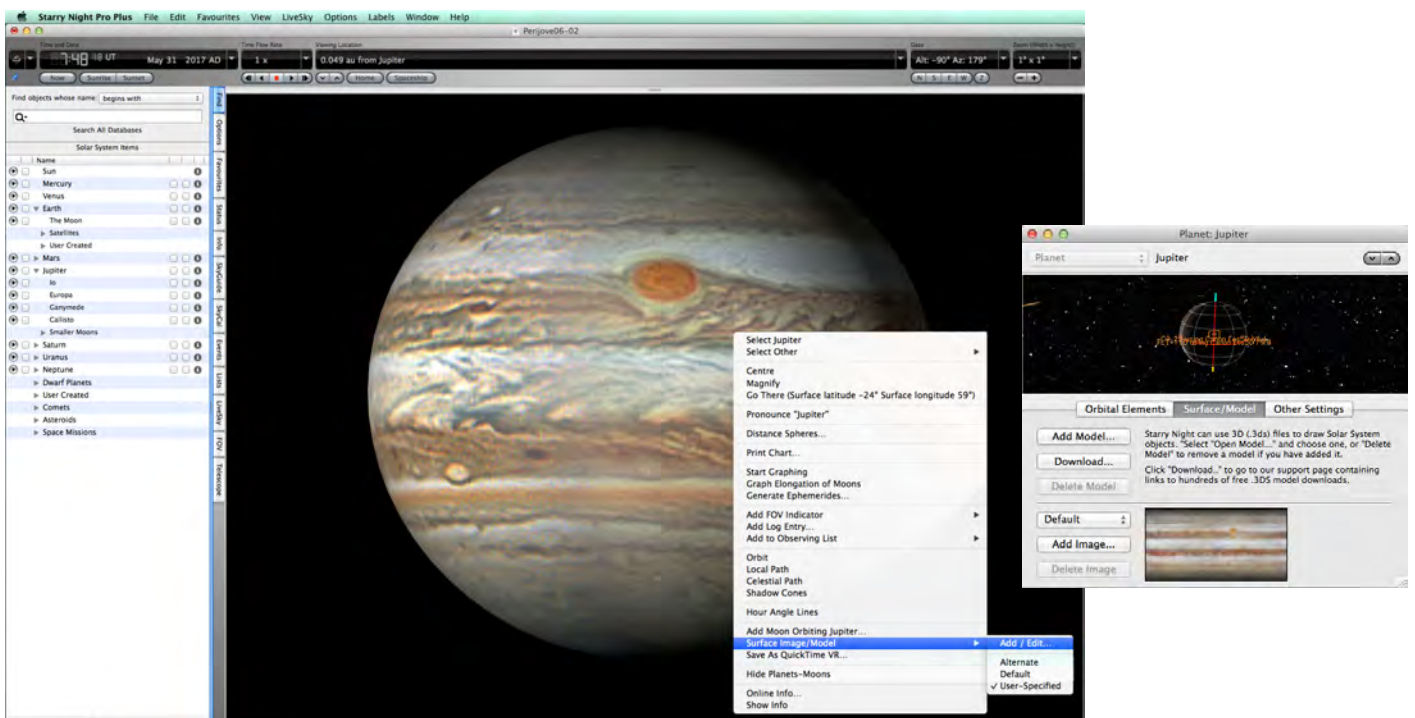
The next step is to bring these maps back to the real shape of Jupiter by projecting them on an ellipsoid.

I found that StarryNight Pro+ from Simulation Curriculum, <https://starrynight.com/ProPlus7/index.html> let you import your own maps on any solar system body.

To do this you need to import your finished maps into Photoshop and use the filter Distort > Spherize with the option Vertical Only, amount: -100. Save them to a new folder



Open StarryNight Pro+ vers. 6 or 7, zoom in on Jupiter and Ctrl click or right mouse click (both are Mac commands) on the planet to open the contextual menu and choose Surface Image Model > Add / Edit and in the next step: Add Image. Browse your folder and chose the map you want to apply on Jupiter.



## Step 6 - Beyond the Equatorial and Polar Maps - Continued

So what are the possible applications when the maps are imported and reprojected on Jupiter?

You have for example the possibility to move out in space and simulate a flyby over the poles as I did in "A Journey to Jupiter".

Although the images are all taken from earth you can visualize close-up views of Jupiter from any direction in space.

To make animations on the other hand is extremely labour intensive as you have to shift map, shift the time and the position in space, take a screen capture and repeat for the next view until you are finished with the sequence. It is a very precise stop-motion technique and I have found no way to automate or speed up these steps that can still take days to perform.

Another application was to simulate the views captured by JunoCam during its 6th perijove on the 19th of May 2017. The main difficulty was that the images from Juno got a higher and higher definition the closer it got to Jupiter while the same views in the images taken from earth were smaller and smaller crops and very difficult to identify in the amateur images.

The upper row shows the original views from JunoCam and the lower row represent the corresponding images mapped in StarryNightPro.

