Orange County Astronomers
AstroImaging SIG
12 Jan. 2016

Meteor Photography

Behind the Scenes...

Meteor Astrophotography Workflow:

- Image Acquisition
- Preliminary Data Set Processing
- Data Set Processing:
  - Composite
  - All-Night Movie
  - GIF Sequence

Image Acquisition

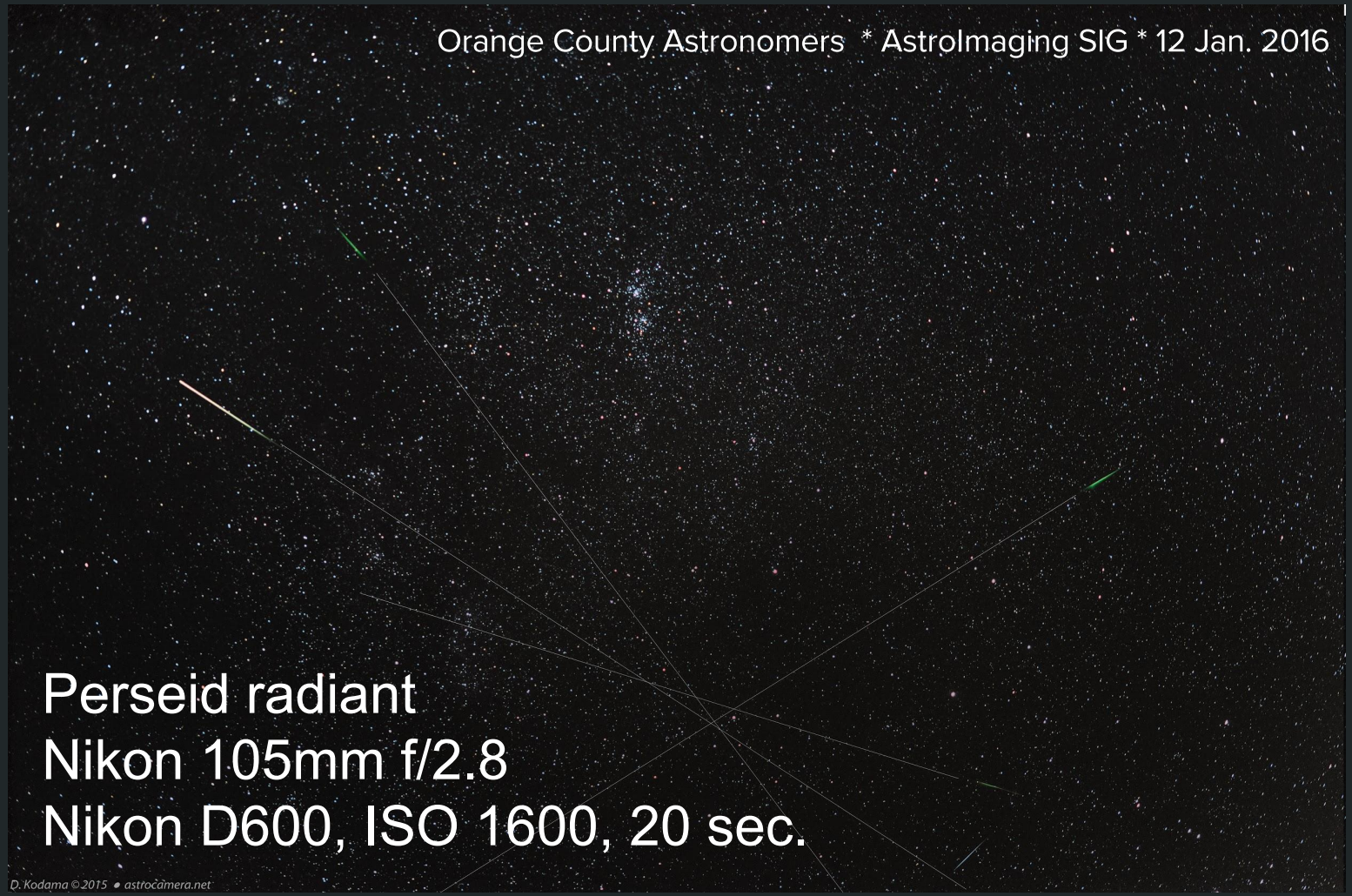
First task is to “find” meteors!

- Sporadic meteors occur randomly every night but are very infrequent

- Best meteor showers:
  - Perseids - August
  - Leonids* - November
  - Geminids - December

* Leonid activity is very high every ~33 years. Last high activity was 1998-2001.

- Sky Conditions - moonless and cloudless is best, but a totally dark sky is not absolutely necessary


Perseid radiant
Nikon 105mm f/2.8
Nikon D600, ISO 1600, 20 sec.
D. Kodama ©2015 • astrocamera.net

Shoot all night to get good results

At 2 frames/minute, a 6-hour night = 720 frames

A “normal” result (for me) during the Perseids

- About 1 meteor per 100 frames
- One bright meteor per night
- Leonids and Geminids have a narrow predicted peak. Outside that window, activity is significantly lower.

Setup Decisions

- To track or not to track?
  - Depends on lens focal length
  - Tracking allows long exposures
  - Not tracking causes trailing of stars
  - Better to not track if landscape is included
  - Less equipment load if not tracking (use fixed tripod)

Rule of thumb to avoid star trailing:

Max exposure =
500 / LensFocalLength

"**Rule of 500**" actually depends on sensor pixel density, amount of photo enlargement, and your preference.

More Setup Decisions

- Battery or AC power?
  - Batteries limit length of imaging (e.g. my D600 shooting once every 30 sec. lasts 3-4 hours)
  - Battery performance decreases in cold weather
  - Batteries may heat up and increase noise
  - Use external (large) battery if that is an option

More Setup Decisions

- Lens focal length?
  - Sky coverage
  - Maximum aperture setting
  - Edge image quality

- Memory card size?
  - Depends on shooting rate, imaging sensor size
  - Always shoot *raw*!

My “standard” setup (Nikon equipment)

- Nikon D600 (24 mpx), or D700 (12 mpx), full frame
- ISO 1600 or 3200, raw
- 2 x 64GB for D600 (1 x 32GB for D700)
- Sigma 15mm f/2.8
- 20-30 sec. exposure, 3 sec. inter-frame delay, internal intervalometer
- AC power adapter
- Fixed tripod
- Framing: includes horizon

50mm f/1.4 lenses are also inexpensive and are supposed to be most “efficient” at capturing meteors, but don’t cover enough sky for my taste.

My Lenses

- My favorite is Sigma 15mm fisheye f/2.8, wide open. This lens is also available for Canon. This lens essentially covers what you can see with your eye.
- An alternate is a Rokinon (Samyang) 8mm fisheye f/4. This lens covers nearly the whole sky and is very inexpensive, but is slow and not very good at the edges.


D. Kodama © 2015 astrocamera.net

8mm

15mm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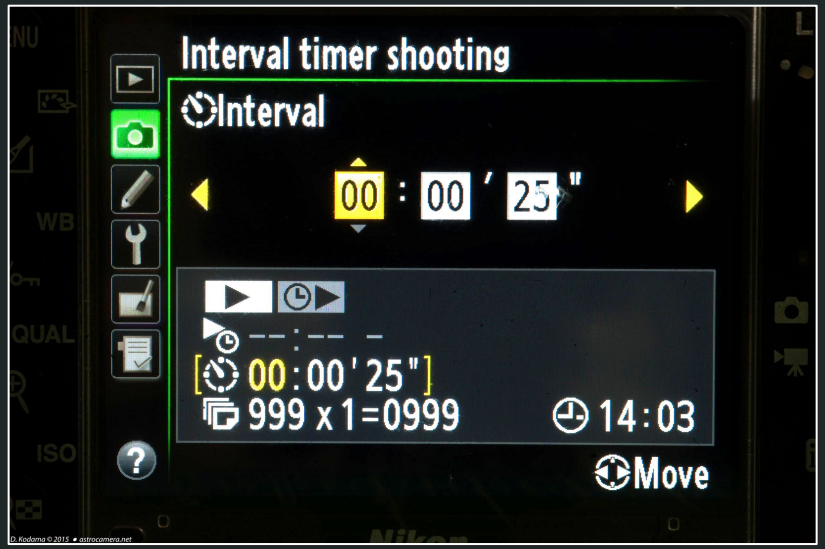
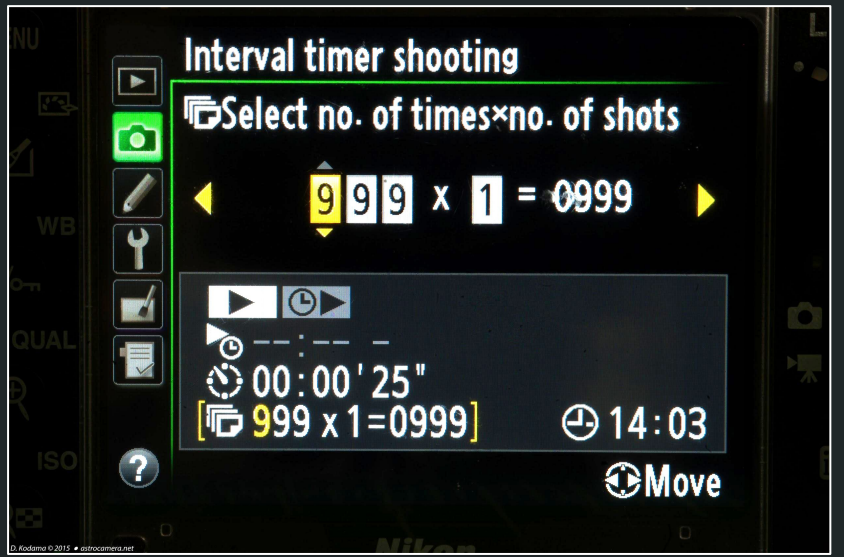
Time-lapse automation

Normally, you will need an external intervalometer to automate shooting the frames all night.

In the case of higher-end Nikon cameras, an intervalometer function is built into the firmware.

Nikon built-in intervalometer setup





Preliminary Data Set Processing

For the image processing described below, I mostly use Adobe's **Lightroom** and **Photoshop**. These are available on a subscription basis for $10/month as a "Creative Cloud" (CC) package.

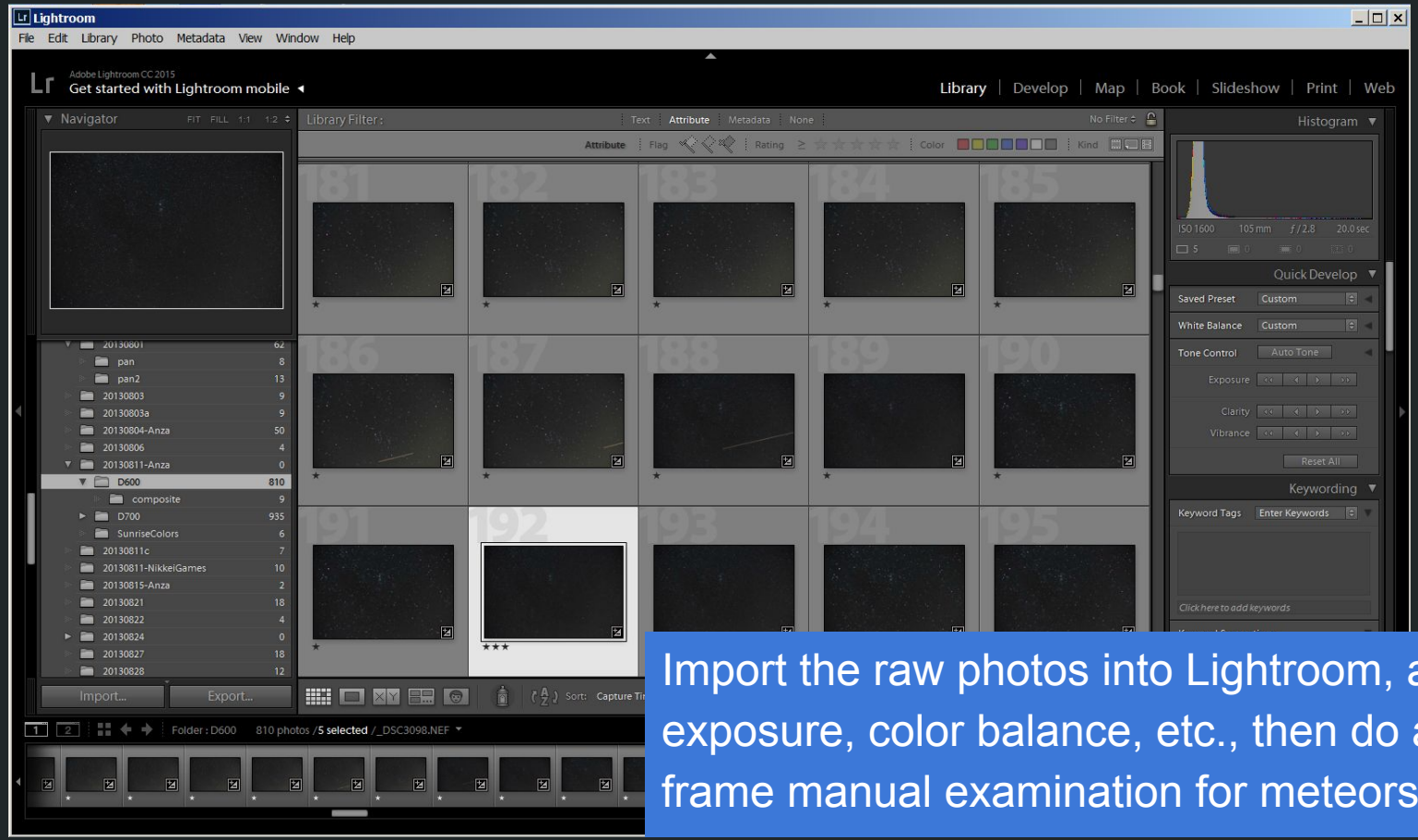
Note that the process described here is only one of many ways of doing the processing…

Note:

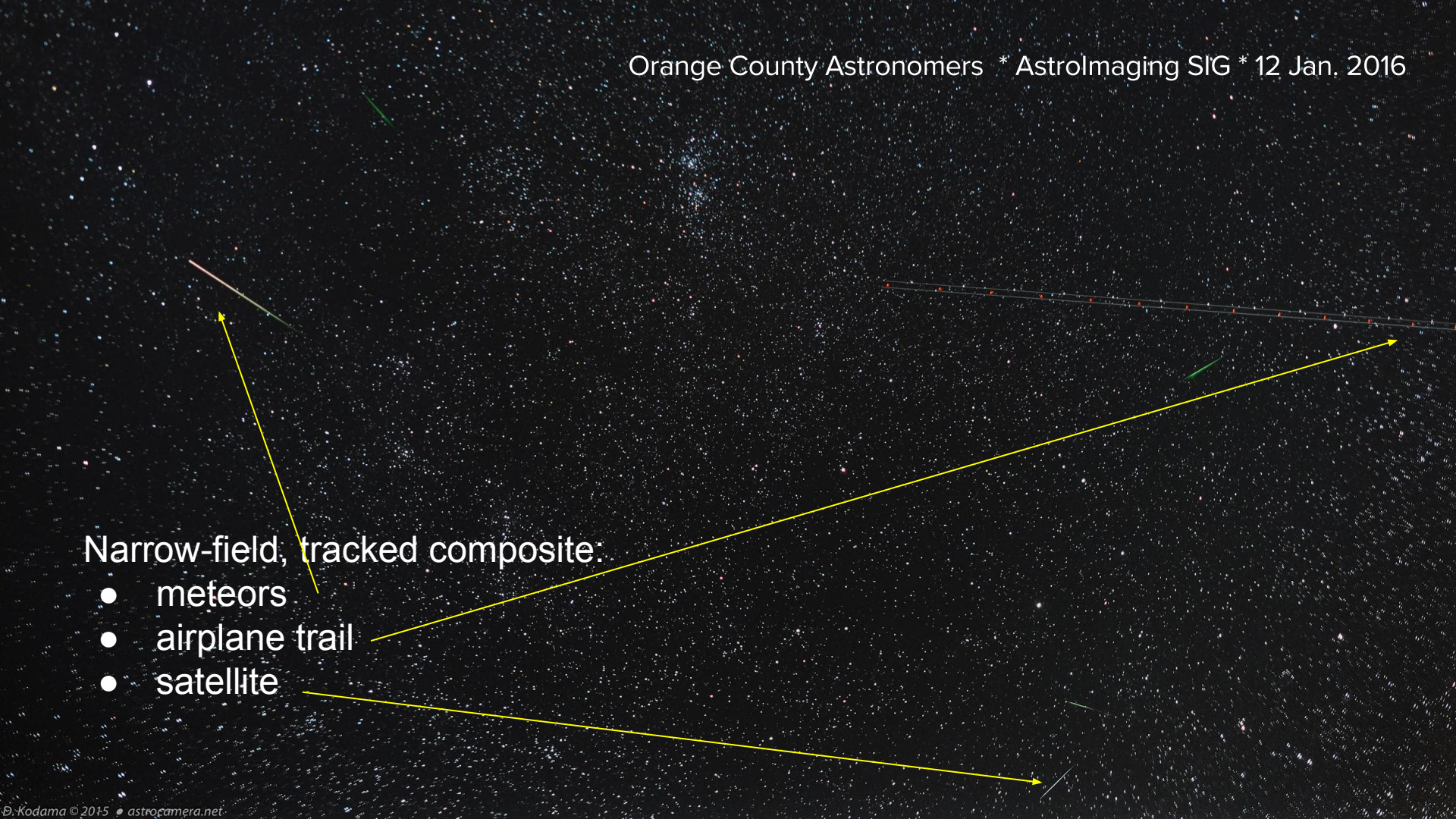
If you are just starting out, try the processing described here with a small subset of data (e.g. 50 frames). The full processing of a night's data can take a frustratingly long time even on a fast computer. I use a recent (2013) Core I7 pc with 16GB of RAM.

For the preliminary processing steps, I use **Lightroom**:

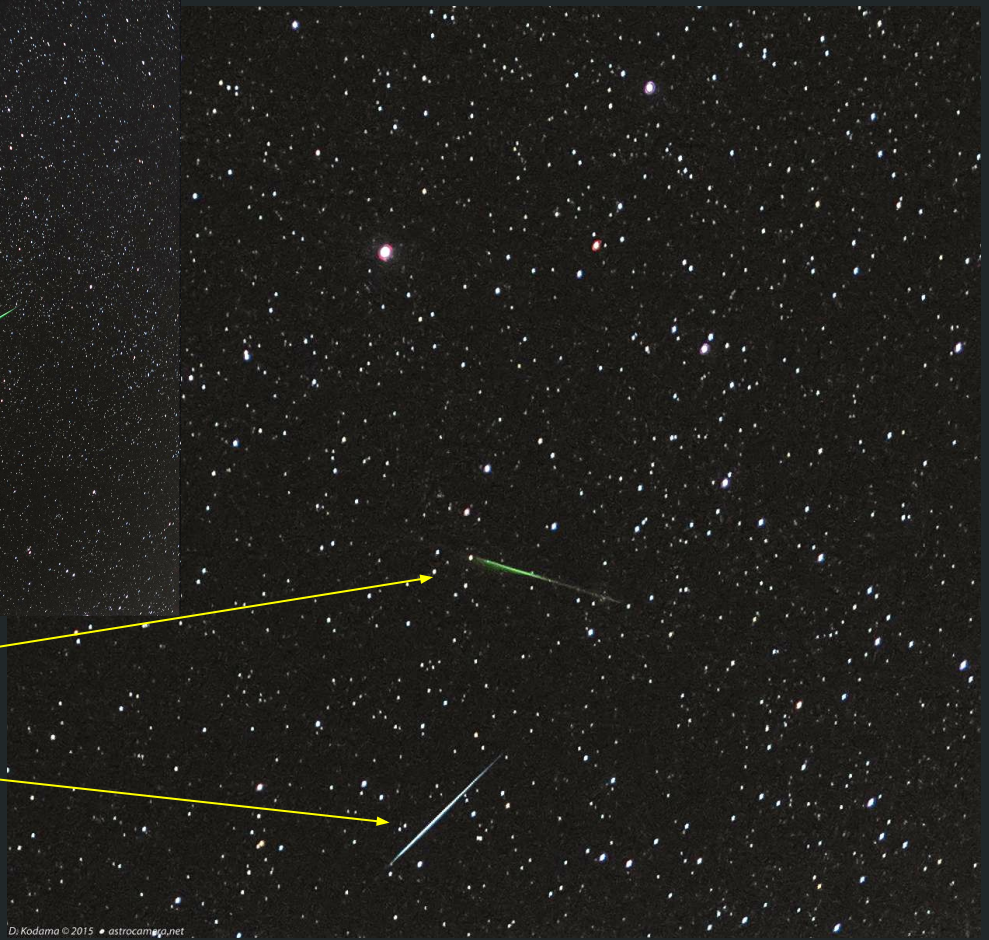
- Import all frames into Lightroom.
- Pick a ‘typical’ frame (i.e. not close to dusk or dawn) and process it for exposure, noise reduction, etc.
- Replicate the processing to all frames in the data set.
- Examine each frame at full size to find the frames with meteors. Use Lightroom’s ‘color’ or ‘star’ markers to mark these frames for later processing.



Import the raw photos into Lightroom, adjust exposure, color balance, etc., then do a frame-by-frame manual examination for meteors..



Meteor showers converge on a radiant point, and show distinct colors while satellite reflections are white and/or are found in multiple frames.



Data Set Processing: Composite

Procedure for creating a composite image from a tracked data set:

- Select only meteor frames into Lightroom.
- Export selected frames into a layered Photoshop file.
- Use photoshop to align the frames (Edit / Auto-align Layers - use “collage” option to limit adjustments to rotation, translation, and scaling)
- Change the mode for all frames above the bottom one to “lighten” mode. You may have to create a mask around the meteor and/or adjust the exposure or color balance for a frame to match the base frame because of lighting changes throughout the night.
- Save the file as a layered .psd file and re-import it into Lightroom.
- Crop and do final touch-up in Lightroom.

Composite created from stationary, tripod-mounted 15mm fisheye lens on camera.

Creating a composite image from a stationary camera, especially with the horizon in the shot, is unfortunately much more complicated!

Aligning frames requires a program which can handle non-linear distortions due to using wide lenses as well as atmospheric refraction. For these problems, I use **Registar** (not Registax) to warp and align the frames.

Registar - https://aurigaimaging.com/

Compositing from a stationary camera:

- Import frames into Lightroom
- Adjust exposure, color balance, etc. and replicate to all frames
- Manually examine frames for meteors, flagging these frames.

- Export meteor frames from Lightroom to a set of 16-bit TIFF files for alignment.
- Using Registar for alignment, select the earliest frame in the set as a reference, then process the rest for alignment. *If the latest frames do not overlap the reference frame enough, you may have to create an intermediate reference image by creating a mosaic of earlier frames.*

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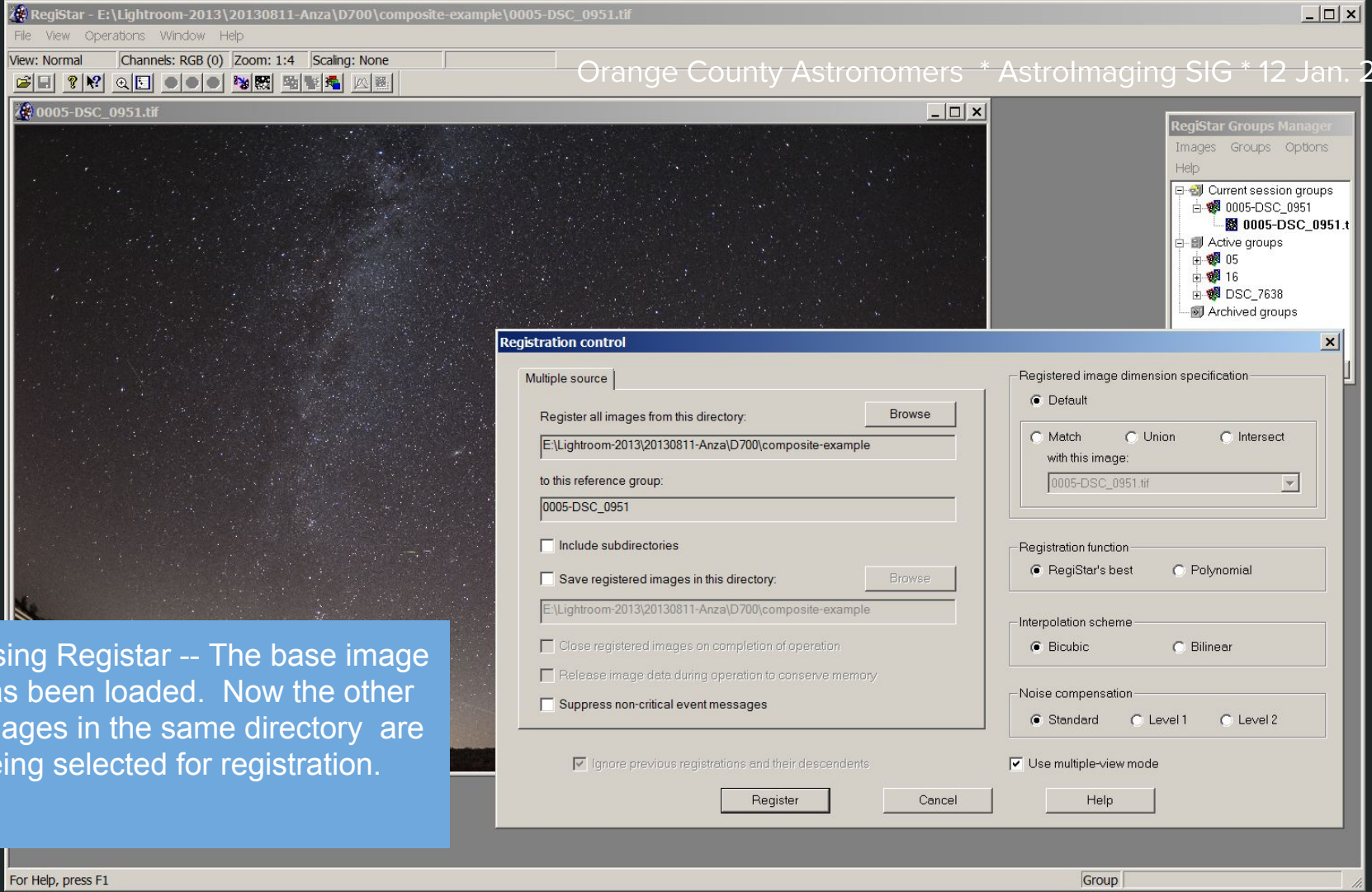
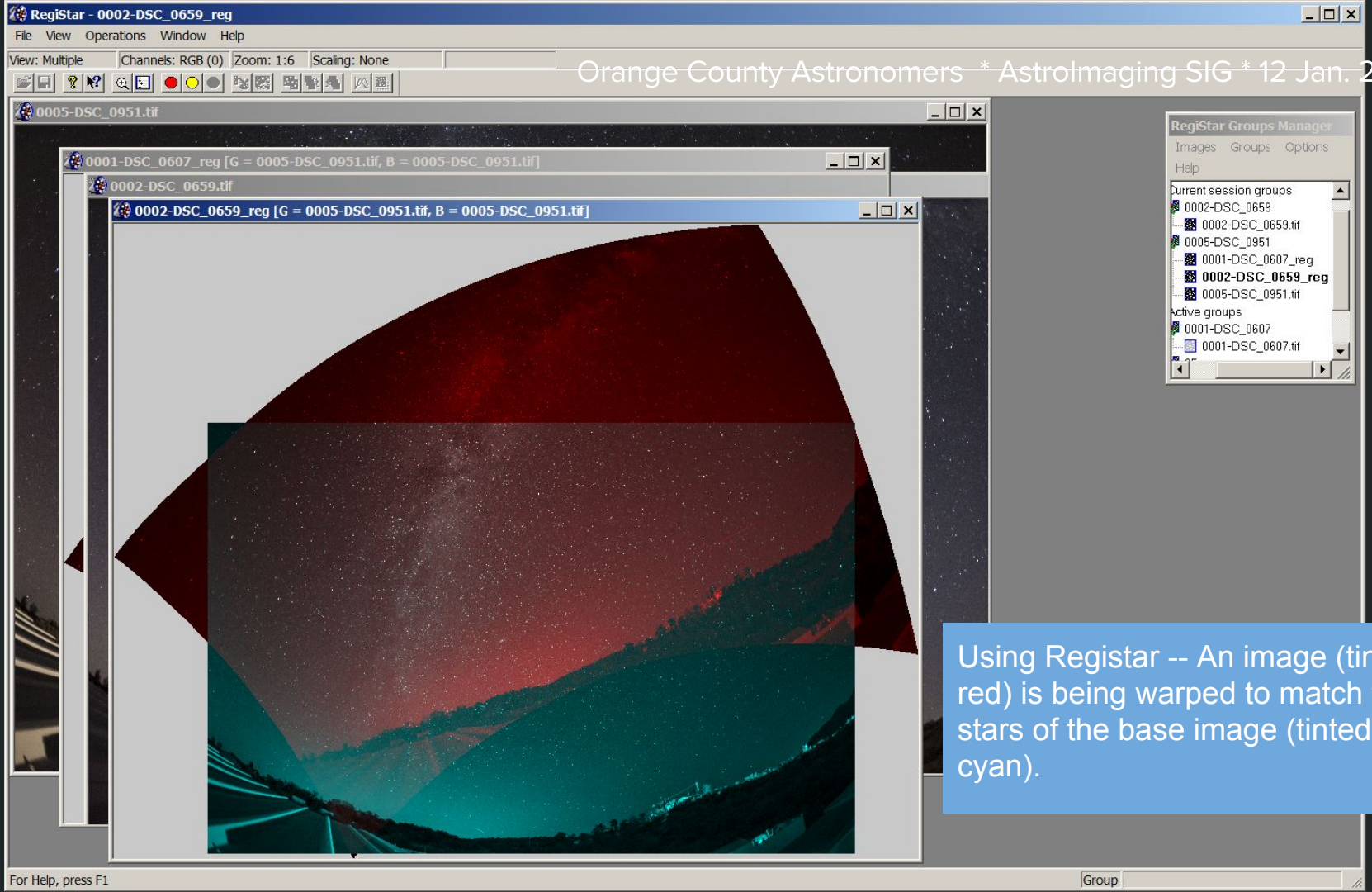
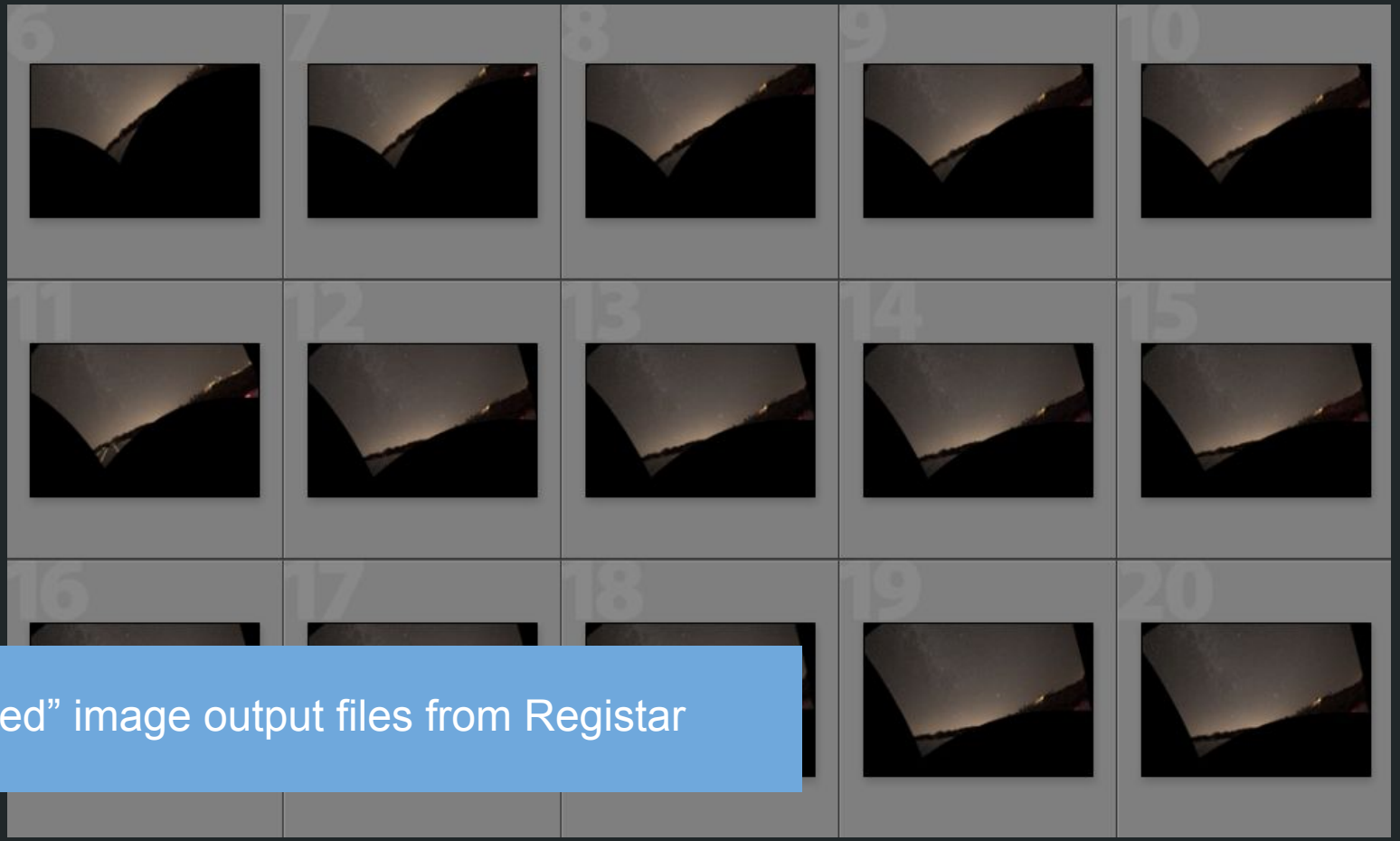


Using Registar -- The base image has been loaded. Now the other images in the same directory are being selected for registration.



Using Registar -- An image (tinted red) is being warped to match the stars of the base image (tinted cyan).



“Warped” image output files from Registar

...Compositing from a stationary camera:

- After aligning with Registar, you should have a collection of “warped” TIFF image files.

- Open Photoshop and bring the warped files into Photoshop layers. Use “File / Scripts / Load Files into stack”. Do not use the auto-align option if it is offered.

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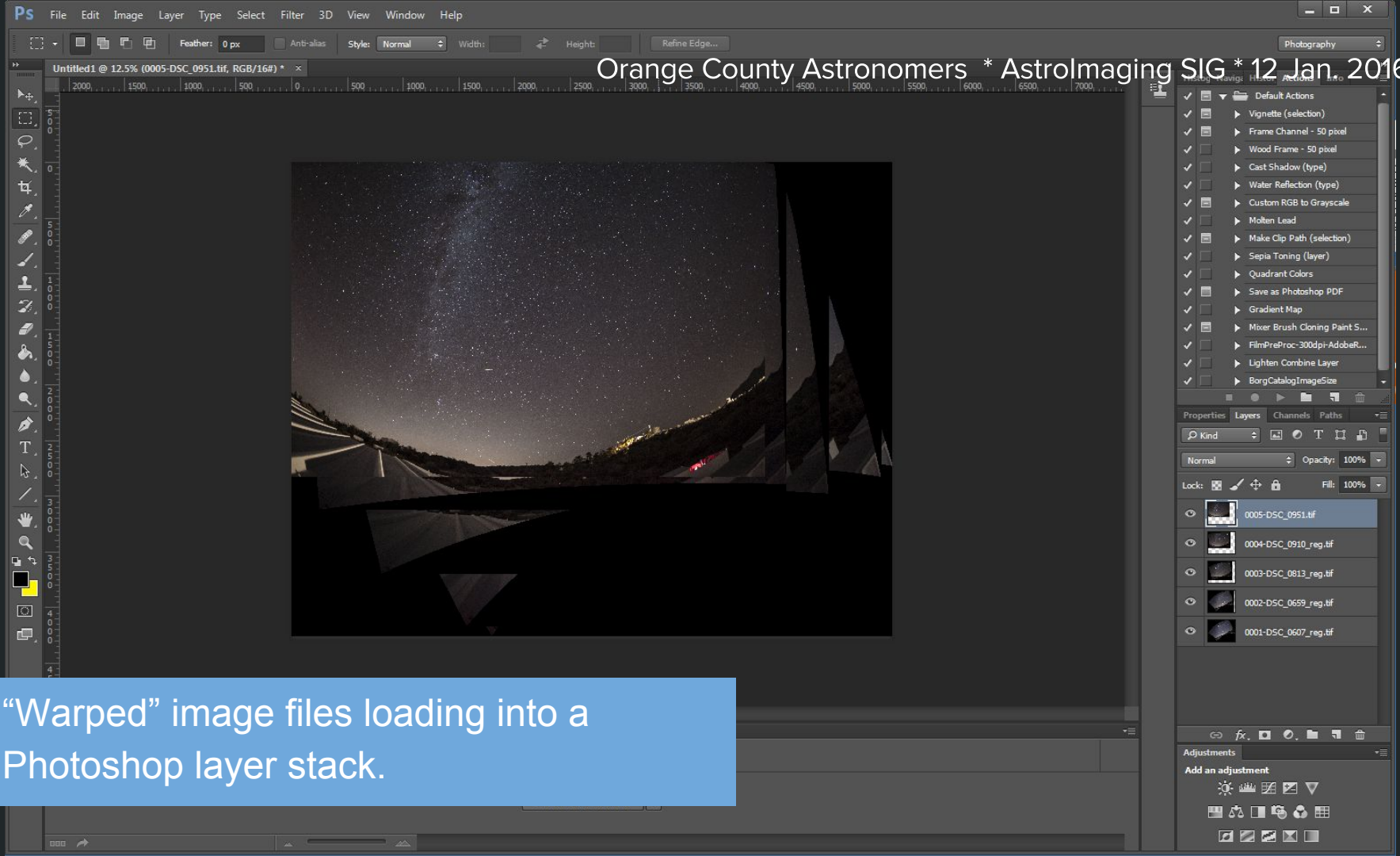

"Warped" image files loading into a Photoshop layer stack.

...Compositing from a stationary camera:

- Manually align the files using x-y translation only.
  - Increase the size of the canvas to accommodate the composite image if necessary.
  - Place the reference frame at the bottom of the stack.
  - Turn off all layers above the reference frame except the one to be aligned
  - Set the transparency of the frame being aligned to ~60%
  - Move the frame in x-y until the stars near the meteor are aligned.

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...Compositing from a stationary camera:

- Manually align the files using x-y translation only (cont.)
  - Reset the layer transparency to 100%
  - Set the blending mode to “Lighten”
  - Create a mask for each layer to mask out everything except in the vicinity of the meteor.

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...Compositing from a stationary camera:

- Adjust the color and/or brightness of each layer by adding an adjustment layer if necessary.

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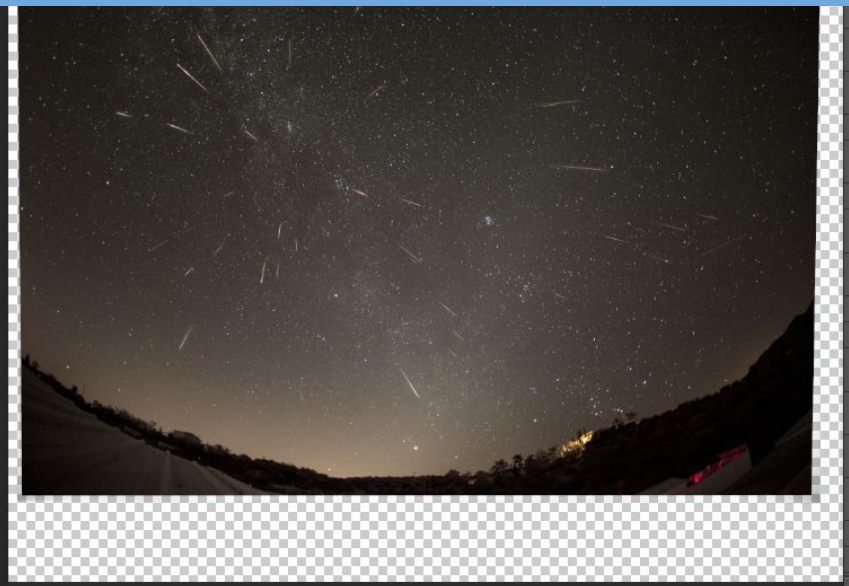
Adjusted, layered composite in Photoshop -- Each warped frame has been manually aligned (x-y), color-matched, and masked to overlay (‘Lighten’ mode) the base frame.



...Compositing from a stationary camera:

- Save the layered file as a Photoshop .psd (or .psb if >2GB).
- Save a flattened TIFF file for importing back into Lightroom
- Use Lightroom to make final adjustments (cropping, color adjustments, etc.)

Data Set Processing: All-Night Movie

To create a time-lapse movie from your data set:

- In Lightroom, select all frames (not just meteor frames) and export them as jpeg files with a maximum height of 1080 pixels (for a 1080p HD movie). Direct the output files into a subdirectory called “movie” and set up Lightroom to output the files with a sequential 4-digit prefix to avoid potential wrap-around of camera file names.

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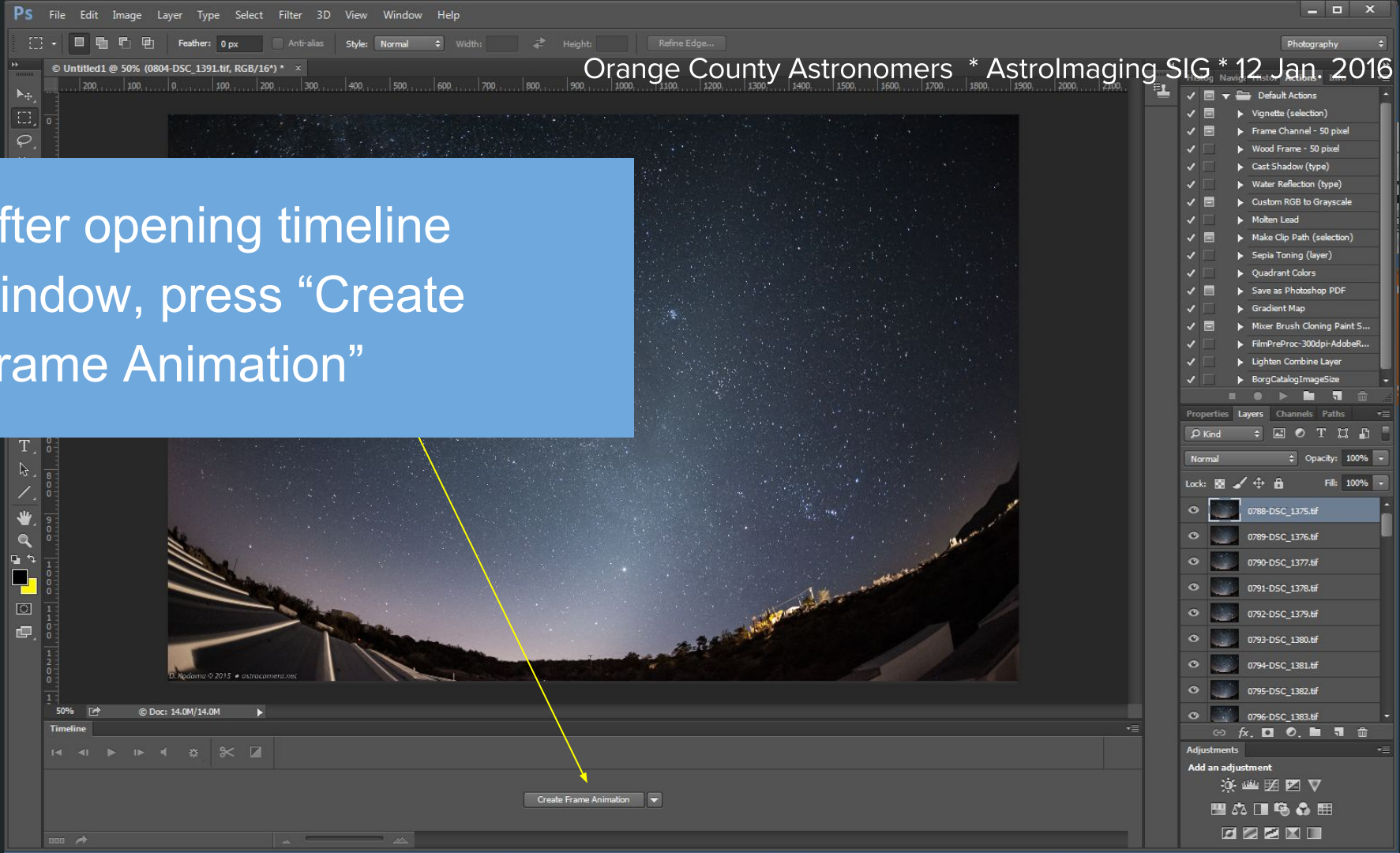
… To create a time-lapse movie from your data set:

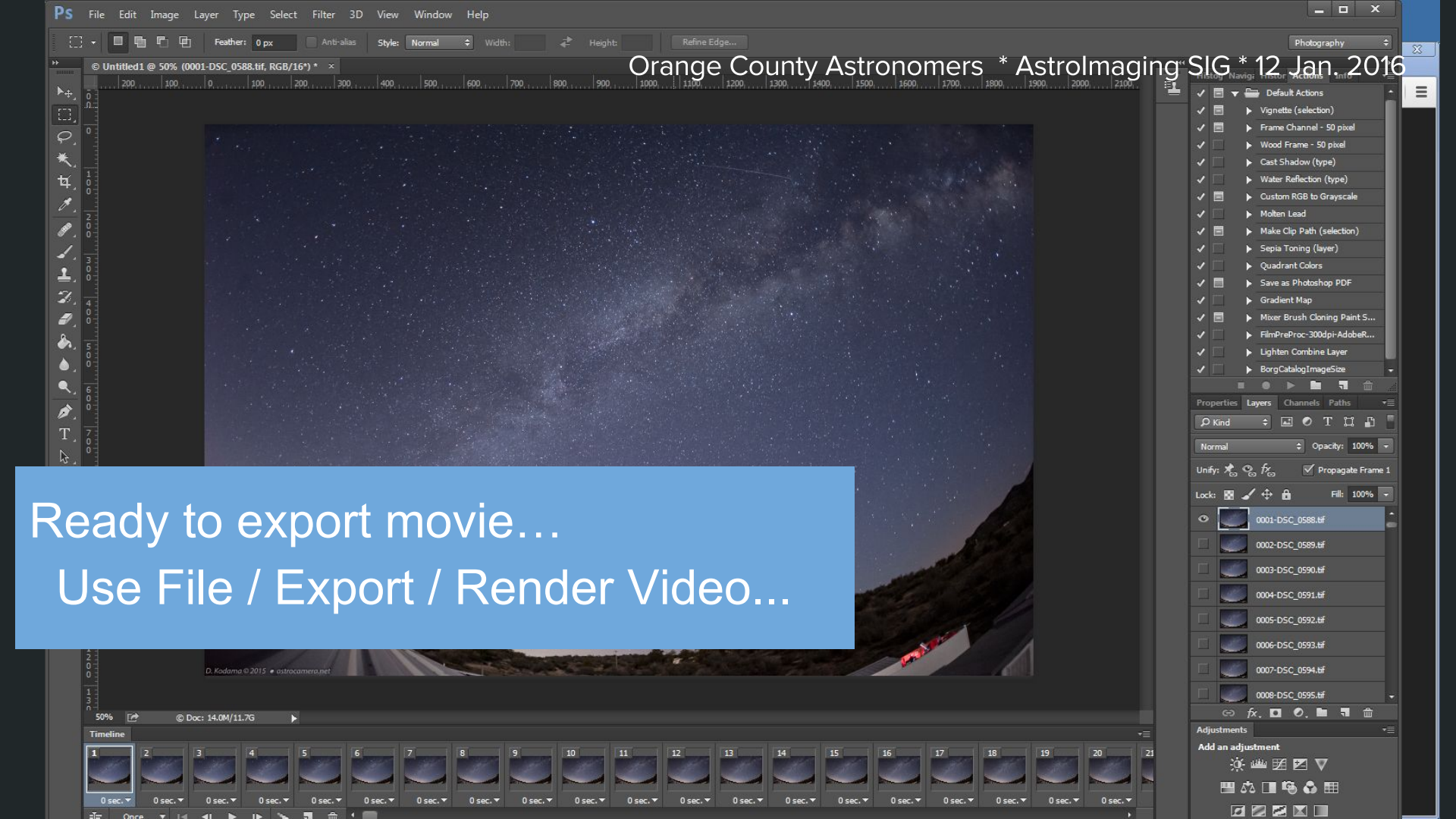
- In Photoshop, import all of the movie directory .jpg files into layers with “File / Scripts / Load Files into Stack…”
- Open the timeline window with “Window / Timeline” and press “Create Frame Animation” in the timeline window.

…

After opening timeline window, press “Create Frame Animation”

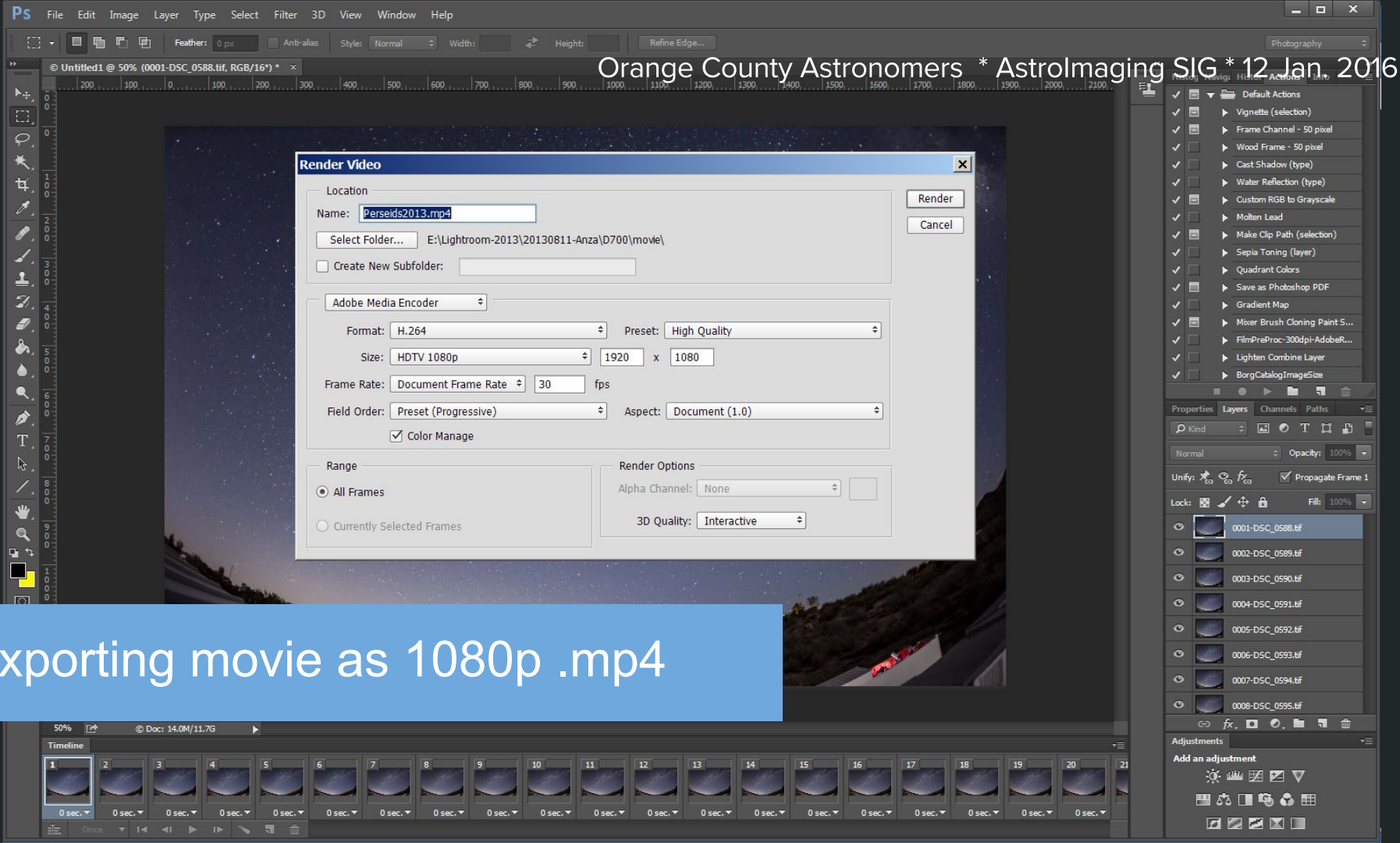


Next open the menu for the timeline window and select “Make Frames from Layers”, followed by “Reverse Frames”



Ready to export movie…

Use File / Export / Render Video...



Exporting movie as 1080p .mp4

An alternative method for creating a movie from frames is to directly drop them into video editing software such as Adobe's Premier Elements or Premier (pro version).

Data Set Processing: Animated GIF Sequence

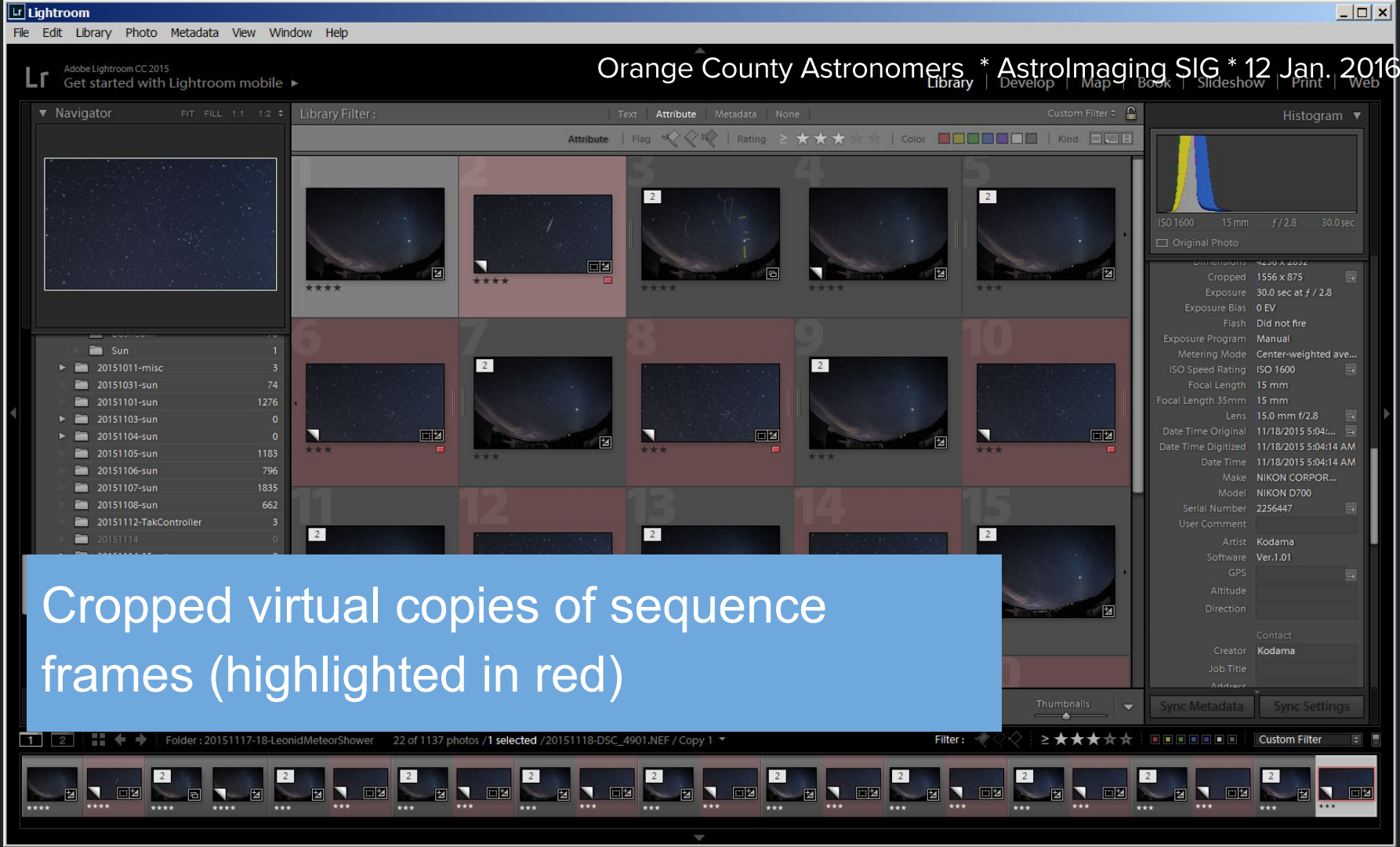
Why create an animated GIF?

- An animated GIF will play in any browser without needing a special player, so it is good for web pages.

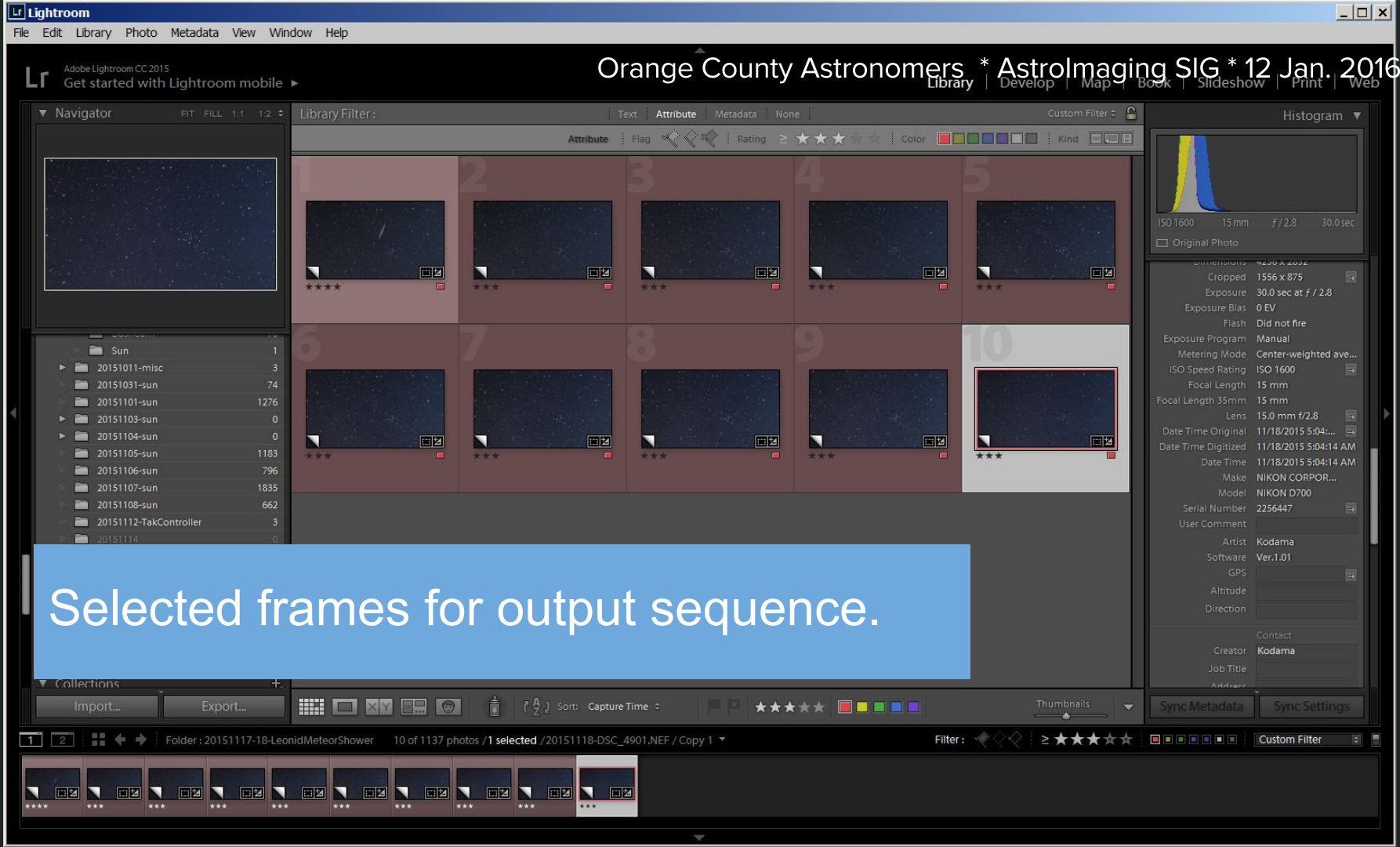
- The disadvantage is that the sequence should be kept small (short and cropped).

To create an animated GIF ‘movie’, the initial procedure is similar to the procedure for the all-night movie, except that you will want to limit the number of frames and crop down to the area of interest.

- Use Lightroom to create virtual copies of the frames of interest, then crop the virtual copies for the animated GIF.



Cropped virtual copies of sequence frames (highlighted in red)



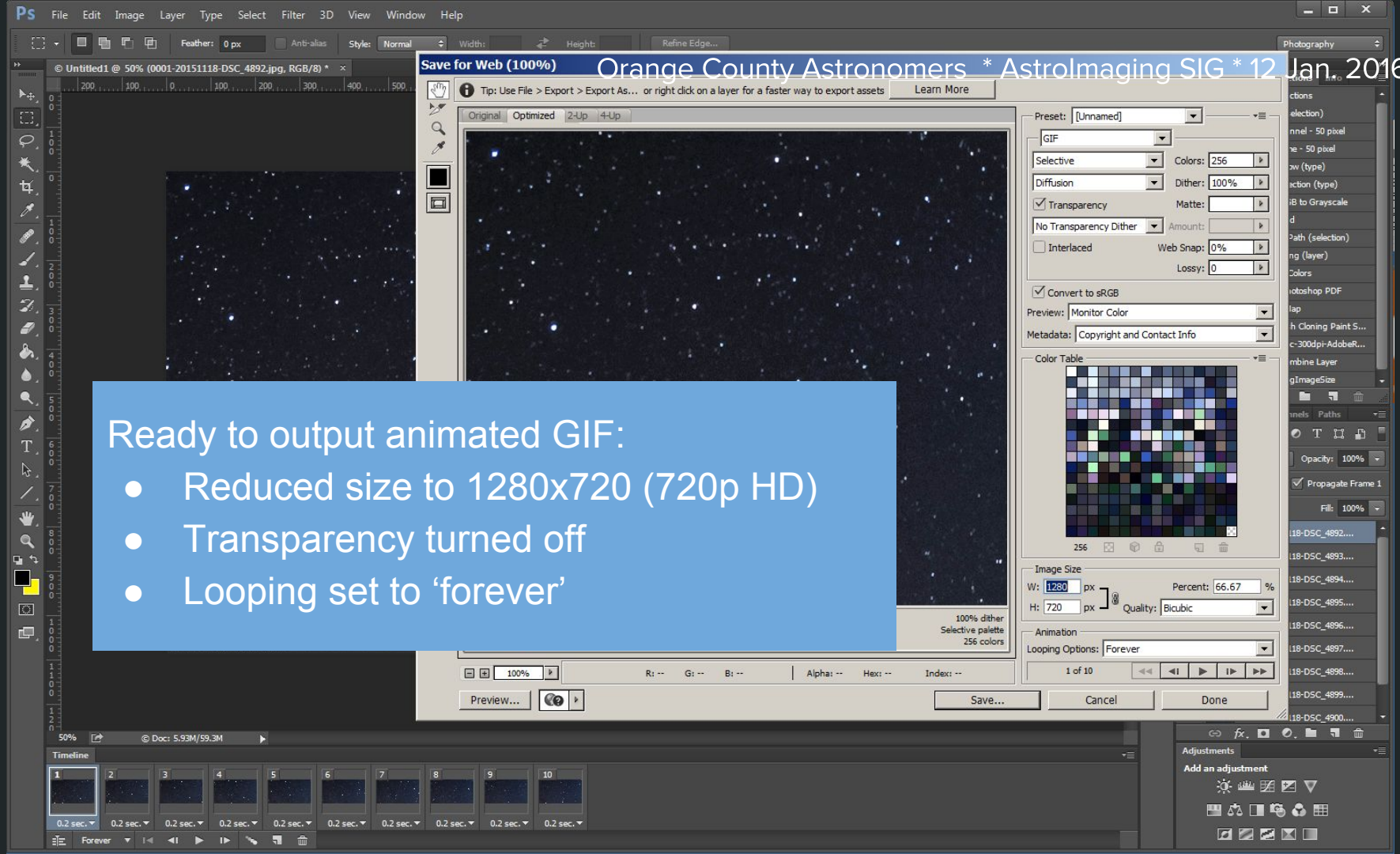
Selected frames for output sequence.

- Once the frames have been selected in Lightroom, export them into a movie subdirectory as cropped .jpg or .tif files.

- Next use Photoshop to import the files into a layer stack and create an animation sequence as was done to create the all-night movie.

- Now export from Photoshop with:
  File / Export / Save for Web (Legacy)...

- Select the GIF output options:
  - Transparency: OFF
  - Looping: Forever
  - Adjust dimensions of output if necessary



Ready to output animated GIF:

- Reduced size to 1280x720 (720p HD)
- Transparency turned off
- Looping set to ‘forever’


The End
Questions? Comments?
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