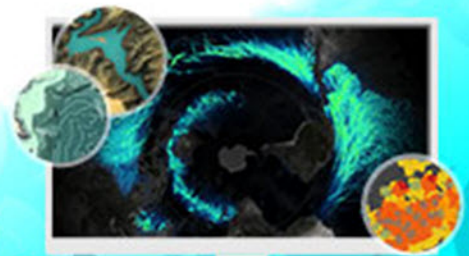


Exercise

Create a Stop-Motion Animation

Section 6 Exercise 4

05/2020



Create a Stop-Motion Animation

Instructions

Use this guide and ArcGIS Pro to reproduce the results of the exercise on your own.

Note: The version of ArcGIS Pro that you are using for this course may produce slightly different results from the screen shots that you see in the course materials.

Time to complete

Approximately 60-90 minutes

Software requirements

ArcGIS Pro 2.5

ArcGIS Pro Standard license (or higher)

Note: The MOOC provides a separate ArcGIS account (user name and password) that you will need to use to license ArcGIS Pro and access other software applications used throughout the MOOC exercises. This account (user name ending with _cart) provides the appropriate ArcGIS Online role, ArcGIS Pro license, ArcGIS Pro extensions, and credits. We strongly recommend that you use the provided course ArcGIS account to ensure that you have the appropriate licensing to complete the exercises. Exercises may require credits. Using the provided course ArcGIS account ensures that you do not consume your organization's credits. Esri is not responsible for any credits consumed if you use a different account. Moreover, Esri will not provide technical support to students who use a different account.

Introduction

This exercise is more advanced than the previous scenario and may require significant revision time as you work to create exactly the kind of video that you want. You are encouraged to experiment; you can always save your work and come back later to refine it.

With all the shipping activity in 1770, it was inevitable that multiple ships would make the same journey within the same year. For one route, from La Coruna in Spain to San Juan in Puerto Rico, there were three journeys made in 1770. The El Rey made the journey once, departing Spain on August 1, and the El Colon made the journey twice, departing Spain on March 3 and again on September 29. This raises the inevitable question of which ship made the journey the fastest and how much faster.

You will create a video that shows this race by working with a dataset that has been normalized down to hours since the departure day rather than using actual dates. This means that the scene can display the three ship locations after 96 hours, or 4 days, and visually show who is leading the race at that point. To make this video, you will use a stop-motion technique not unlike what is used in a flip-book animation, a computer-generated movie (like *Toy Story*) or *claymation* (<https://bit.ly/2ylhRLh>) (like *Wallace and Gromit*). This technique requires a single feature location and orientation for each output video frame, where the act of playing them one after another gives the impression of movement.

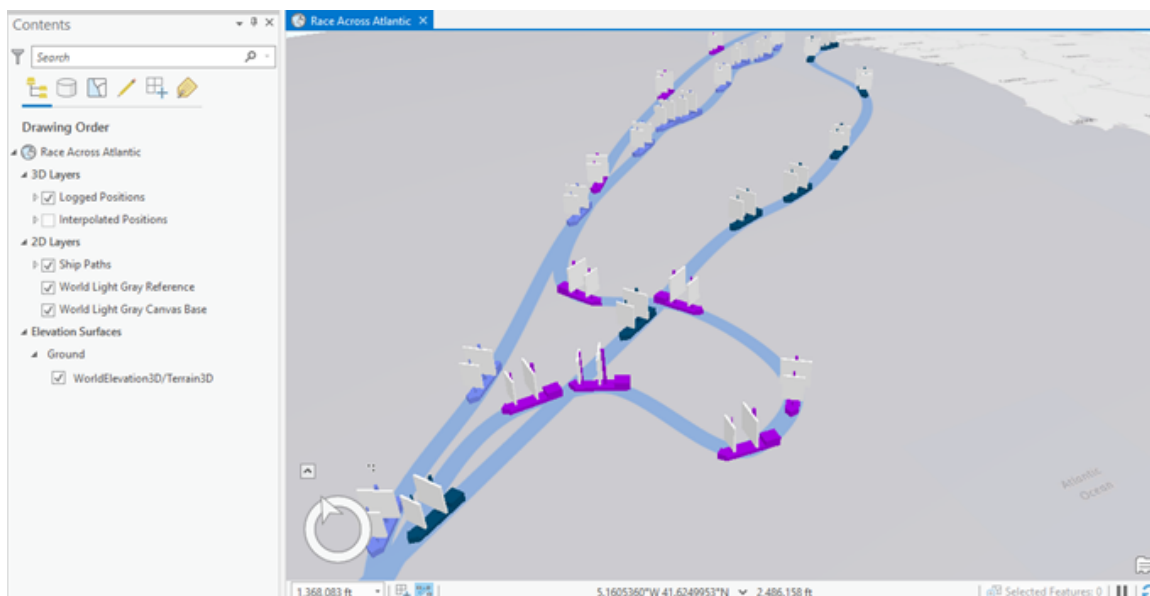
In this exercise, you will create a stop-motion-style animation (<https://bit.ly/1SvKmo6>) of the three ships, using a normalized starting time so that they can "race" across the Atlantic together. You will then share it as a YouTube-ready video.

Note: If you would like a sneak peek of the finished video for this scenario, you can find the Animations_Complete_RaceAcrossAtlantic.mp4 video in the VideoResults folder on your computer where you extracted the exercise data files.

Step 1: Open a map

- a If necessary, start ArcGIS Pro and open the Animations_<your first and last name>.aprx project file that you saved in the previous exercise.
- b At the top of the map window, click the Race Across Atlantic tab to open the map.

The scene is opened in Global view, which is used for large-extent, real-world content where the curvature of the earth is an important element.

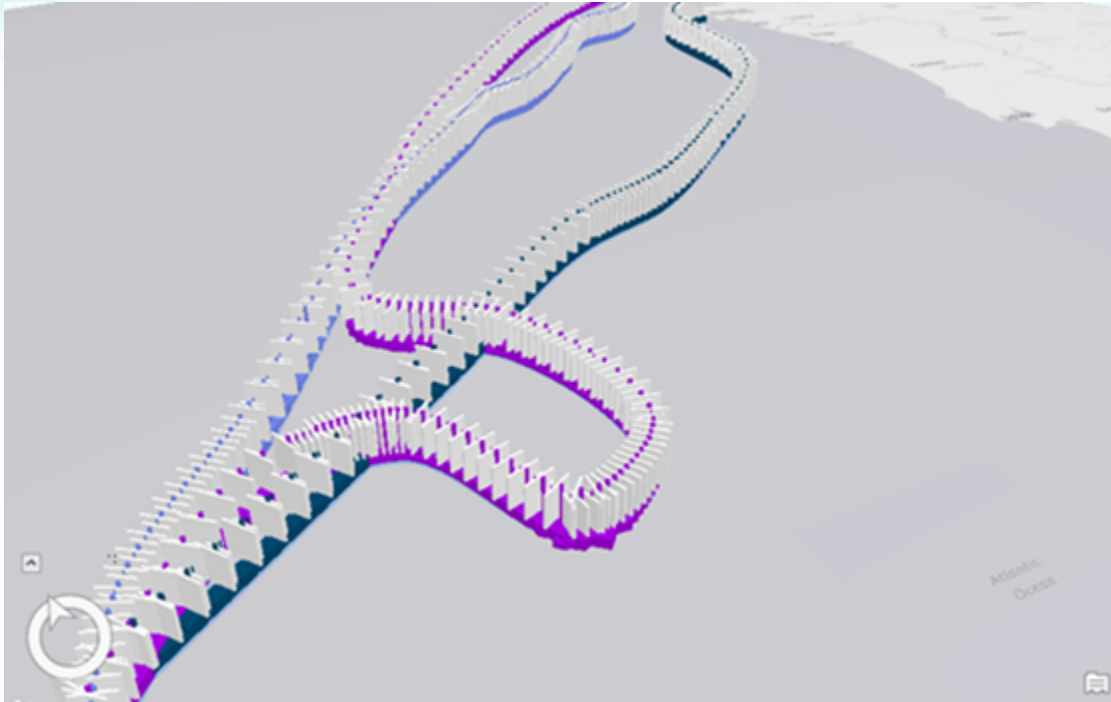


The Race Across Atlantic scene has the following layers pre-authored for you:

- **Logged Positions:** This layer shows the daily logged positions of the three ship journeys from Spain to Puerto Rico in 1770. Each position is symbolized by a large (75 kilometers tall) ship model, oriented along its travel path, so that all three of them can be viewed at the same time. If they were symbolized in their real-world sizes of 15 meters to 20 meters (45 feet to 60 feet) tall, then only ships very close to the camera would be visible.
- **Interpolated Positions:** This layer shows the estimated intermediate positions along the route that have been calculated between the officially logged ones. A Bezier curve was used to calculate the path between the known locations, and a constant travel speed (equal steps) was applied within each segment.
- **Ship Paths:** This layer shows the routes taken for the three journeys. The width of the lines is set to 14 kilometers wide because this is (approximately) the visible distance from the top of a 50-foot-high mast. The lines show that, even if the ships had departed port on the same day, they would have rarely caught sight of each other.

 Turn on the Interpolated Positions layer.

Hint: In the Contents pane, check the box to the left of the Interpolated Positions layer.



Note: It may take some time for the layer to redraw.

You will see that you have all the stop-motion locations that you need for the ships to have their transatlantic race. What is missing is the ability to show each feature in turn.

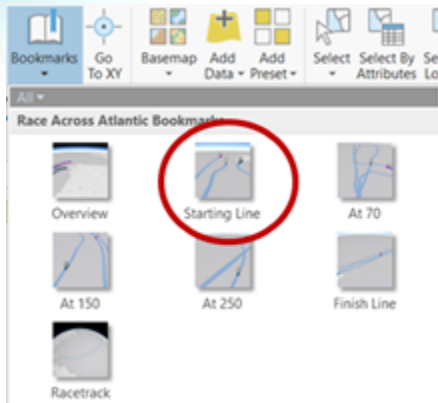
Step 2: Define a per-feature filter using range

A range filter connects to any numeric field and will interactively filter features in the map. For example, you could use the Magnitude field to display earthquakes between 2.5 and 3.5 in strength or the FloorNumber field to display the rooms, printers, and fire extinguishers for Floor 6.

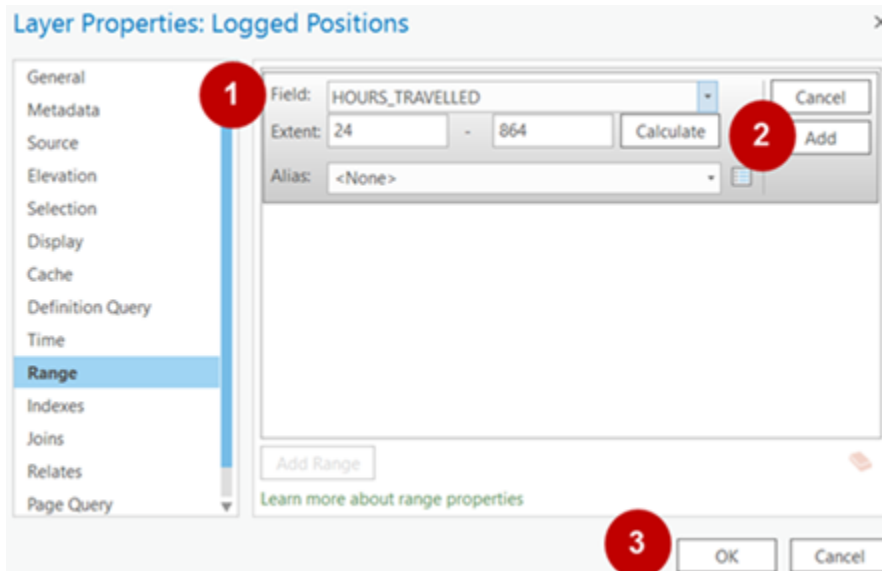
Note: Refer to ArcGIS Pro Help to learn more about [ranges and the interactive range slider control](https://bit.ly/2vzksgR) (<https://bit.ly/2vzksgR>).

For this exercise, the range filter will be connected to the Hours_Travelled field, which indicates how long it has been since the ship left port. By stepping through individual feature locations one at a time, and synchronizing it with the exported video frames, you will create the illusion of a ship moving across the ocean.

- a** From the Map tab, click the Bookmarks down arrow, and then in the Race Across Atlantic Bookmarks section, click the Starting Line bookmark.



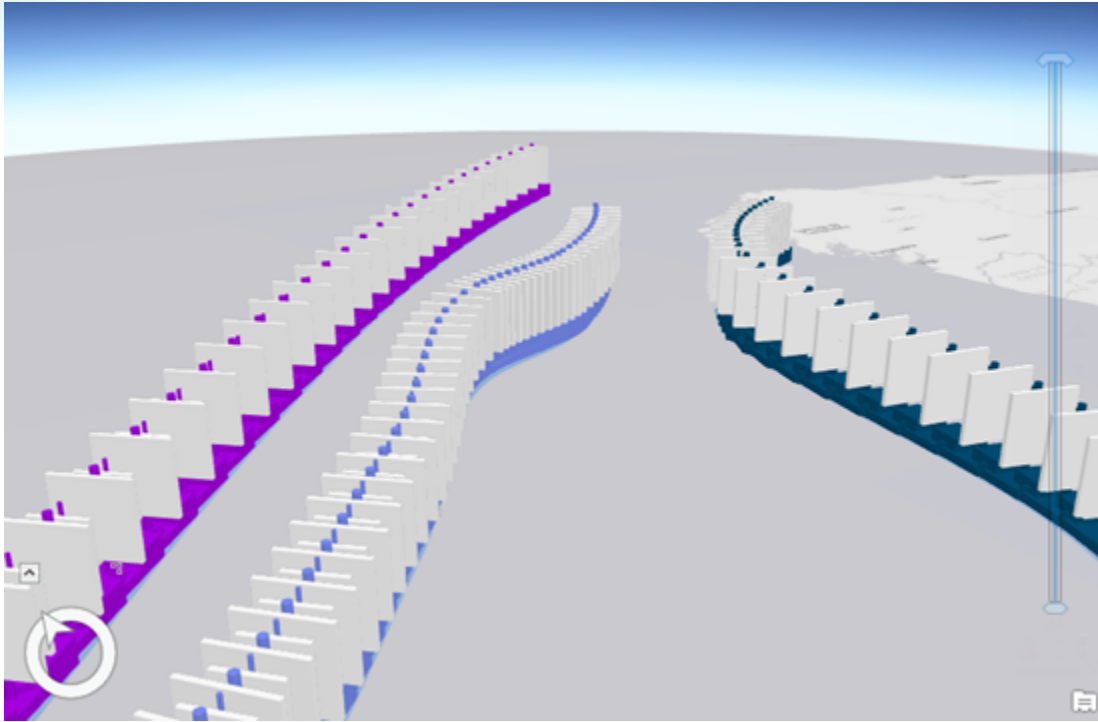
- b In the Contents pane, right-click Logged Positions and choose Properties.
- c In the Layer Properties dialog box, click the Range tab, and then click Add Range.
- d For Field, choose HOURS_TRAVELLED, click Add, and then click OK.



You will do the same thing for the Interpolated Positions layer.

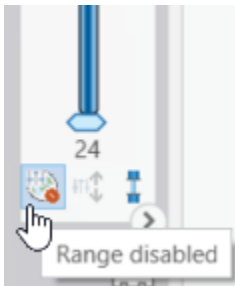
- e In the Contents pane, right-click Interpolated Positions and choose Properties.
- f In the Layer Properties dialog box, from the Range tab, click Add Range.
- g For Field, choose HOURS_TRAVELLED, click Add, and then click OK.

A new on-screen slider control will appear on the right side of the view, along with a Range tab on the ribbon.

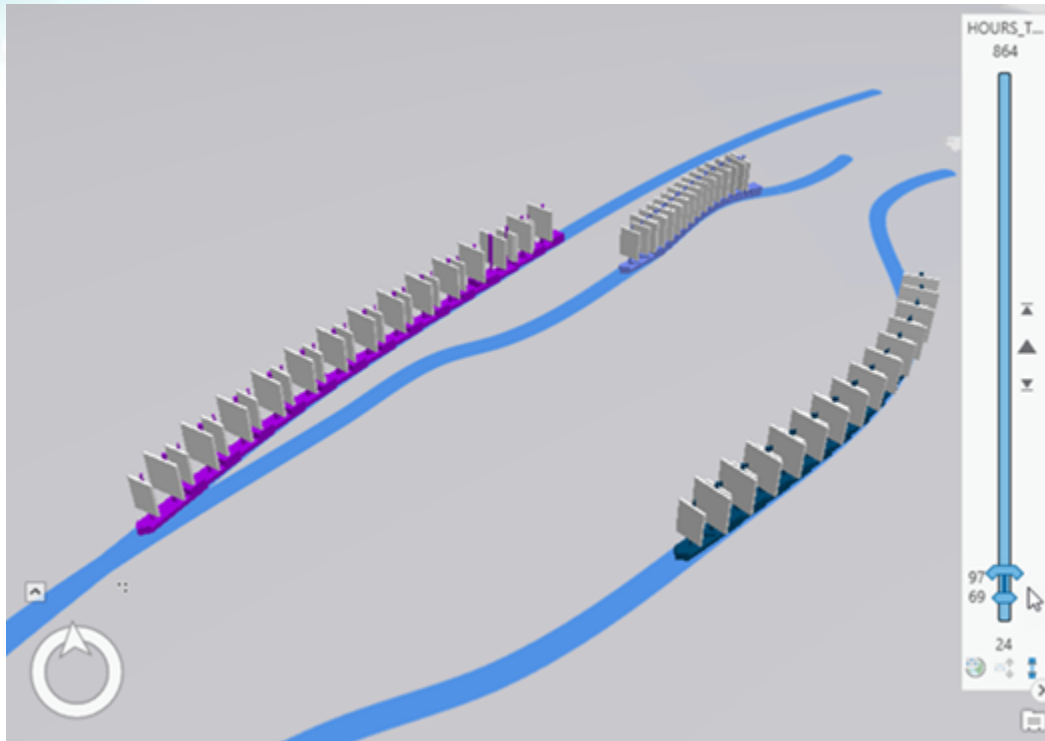


Your scene is now range-aware, but the filter is not being actively applied.

- h Point to the range slider, and then in the bottom-left corner, click the Range Disabled button.



- i Interactively drag the range slider and note how a subset of features is being shown.



- j Zoom out to see more of the ships' paths.

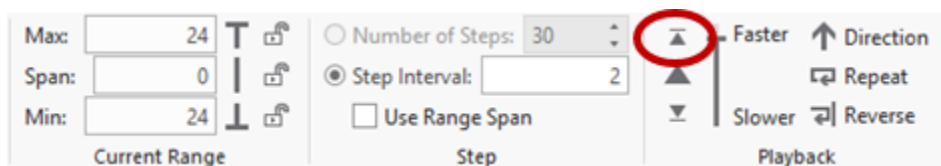
Multiple features are displayed because they all fit within the current range filter. You can set the specific values for the scene's current range and how it should step forward on the tab.

- k From the Range tab, in the Current Range group, set the Max to **24** and the Span to **0**.

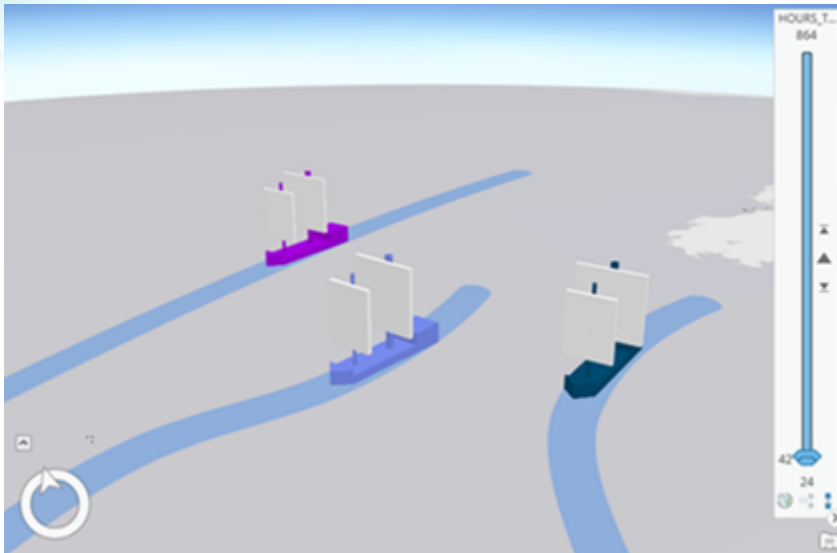
The minimum value means 24 hours into the journey, or after one day at sea. The span value of 0 means one slice of data. A span of 10, for example, would show 10 hours of content, and you would see multiple ships.

- l In the Step group, uncheck the box for Use Range Span and set the Step Interval to **2**.

- m In the Playback group, click the Step Forward button.



You should see a single ship feature appear along each path for each step.



Note: If you have zoomed or panned the map, or if you have stepped forward a considerable number of steps, you may need to reorient yourself to the location of the start of the race to see the ships.

Step 3: Use the range filter to create a stop-motion animation

The range slider is now well-configured to make an animation. You want to create exactly one image, or frame, in the final video for each defined position of the ships, and you can use the range slider configuration to help you do that.

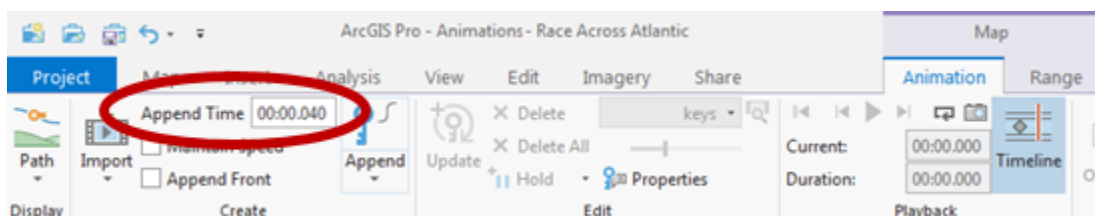
- a** Zoom to the Starting Line bookmark.

Hint: From the Map tab, in the Navigate group, click the Bookmarks down arrow and select the Starting Line bookmark.

- b** From the View tab, in the Animation group, click Add to open the Animation Timeline pane at the bottom of the window.

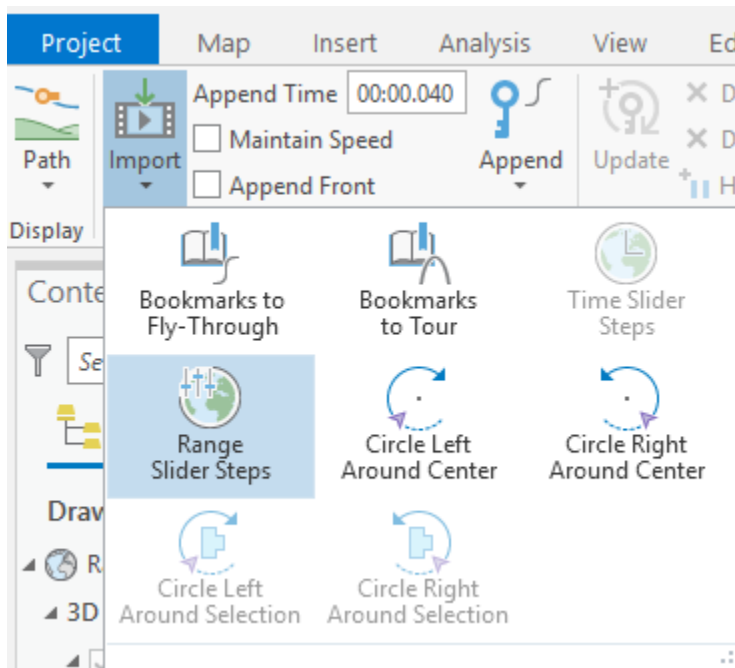
- c** From the Animation tab, in the Create group, set the Append Time to **00:00.040**.

This will create an animation that shows 25 individual states of the range slider per second.

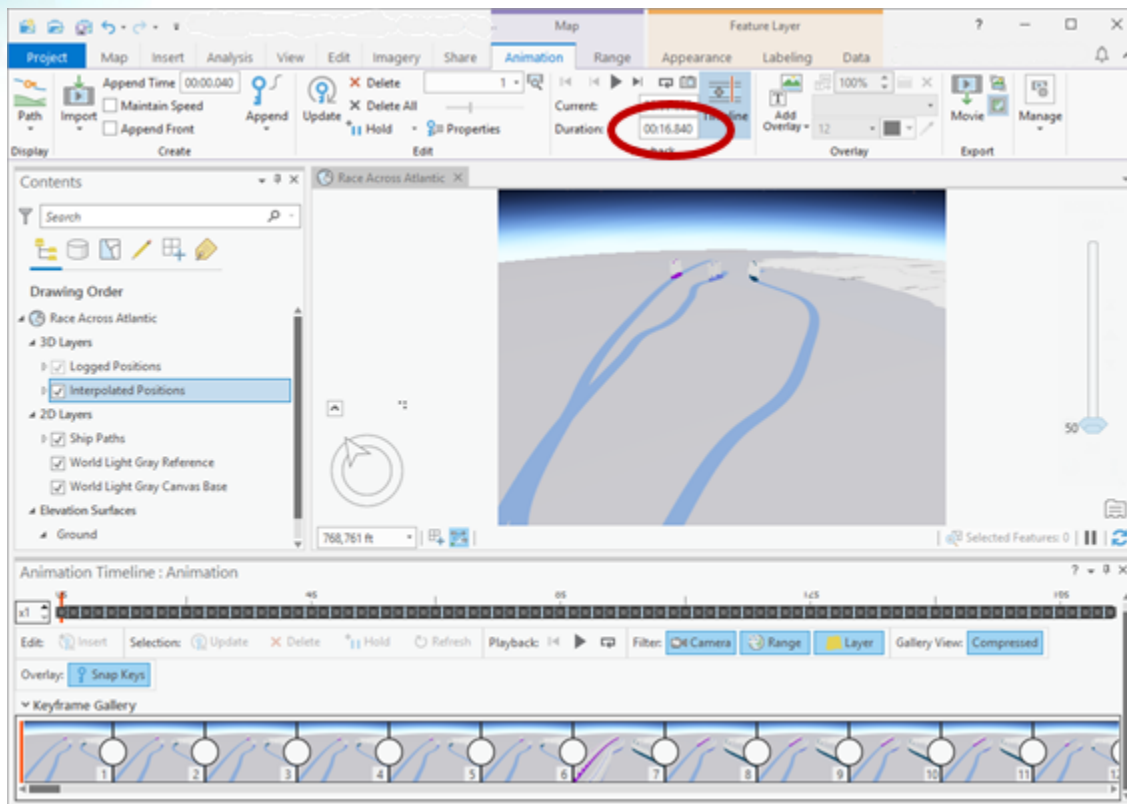


Note: This is important information for later when the video is exported.

- d From the Animation tab, in the Create group, click the Import down arrow and select Range Slider Steps.



This will create an animation with 422 keyframes, one for each two-hour step through the range slider, with a current total playing time of about 16.8 seconds.



The end goal for this animation is a YouTube output. You will update the output format so that you can preview the display in the appropriate aspect ratio.

- e Open the Export Movie pane.

Hint: From the Animation tab, in the Export group, click Movie.

- f In the Export Movie pane, select the YouTube preset.

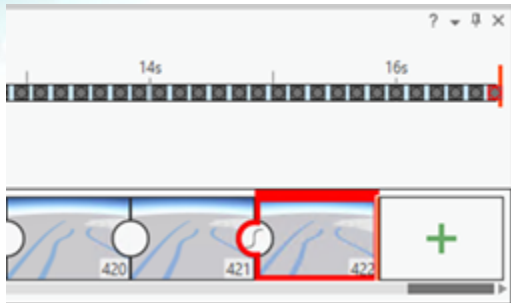
The 1,280 pixels wide by 720 pixels high clipped aspect ratio for the view will update.

- g Close the Export Movie pane.

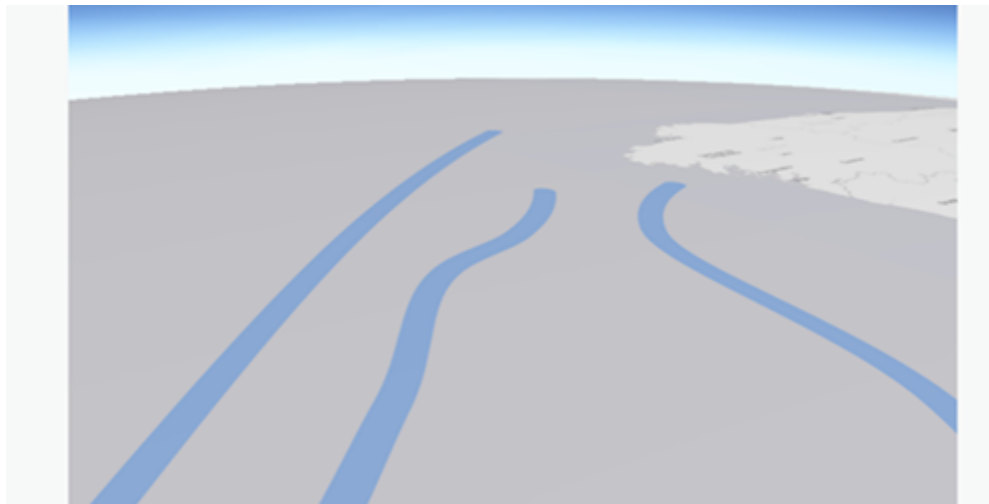
- h In the Animation Timeline pane, scroll through the frames until you see the last keyframe, 422.

Hint: Click and drag the horizontal slider at the bottom of the Animation Timeline pane to scroll to the last keyframe.

- i Double-click keyframe 422 to move to that part of the animation.



Note: You can also right-click the keyframe and choose Zoom To.



The ships will disappear (because they have finished the race), but the camera has stayed in the same location. That is, it is still at the *starting* line. This is how the Import Range Slider Steps process works; it does not know where you want the camera to move to next, so it leaves it in the same place. You will update some of the keyframes so that the camera knows where to move.

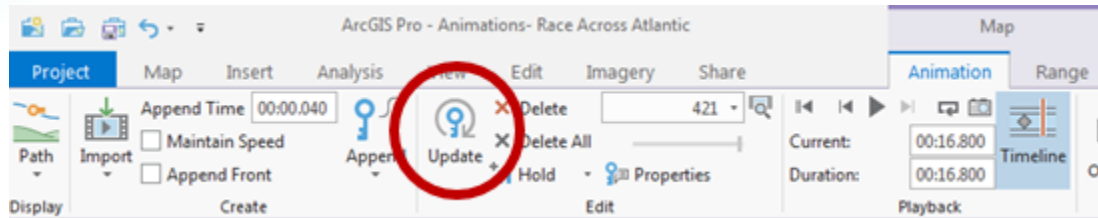
Step 4: Update the last keyframe to show the end of the race

You need to move the camera to the end of the race, and then update the keyframe. For simplicity, this camera position and others along the way have been created for you as bookmarks.

- a** Zoom to the Finish Line bookmark.

Hint: From the Map tab, click the Bookmarks down arrow and select the Finish Line bookmark.

- b From the Animation tab, in the Edit group, click the Update Keyframe button.



The last keyframe is when the *slowest* ship arrives. You need the camera to get to the finish line when the *fastest* ship arrives, and then hold the same viewpoint until all the ships finish. The data shows that the winner arrives in 29 days of travel, which means that there were 348 (29 x 12) range slider steps for it to arrive, so the arrival keyframe is #349.

- c In the Animation Timeline pane, scroll through the frames until you see keyframe 349.
 d Zoom to keyframe 349.

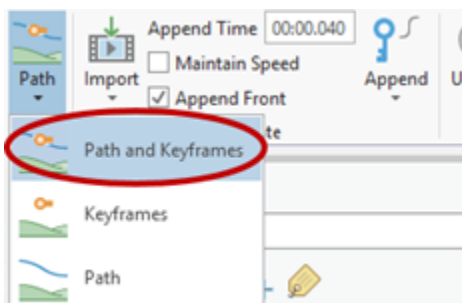
Hint: Double-click the keyframe to zoom to it.

- e Zoom to the Finish Line bookmark.
 f From the Animation tab, in the Edit group, click the Update Keyframe button.

Note: Ensure that you update the keyframe from the Animation tab, not from the Animation Timeline pane.

You can confirm the camera's flight path by enabling a visual display of the line that represents the path.

- g Zoom to the Racetrack bookmark.
 h From the Animation tab, in the Display group, click the Path down arrow and select Path And Keyframes.



Note: The button turns blue when it is enabled.



You are now looking at the camera's flight path. From this viewpoint, you can see that the ships' paths are curved, and the direct flight path between the start and finish (which is what you have now) will not keep the ships in view. Some of the intermediate keyframes must be updated to follow the race more closely.

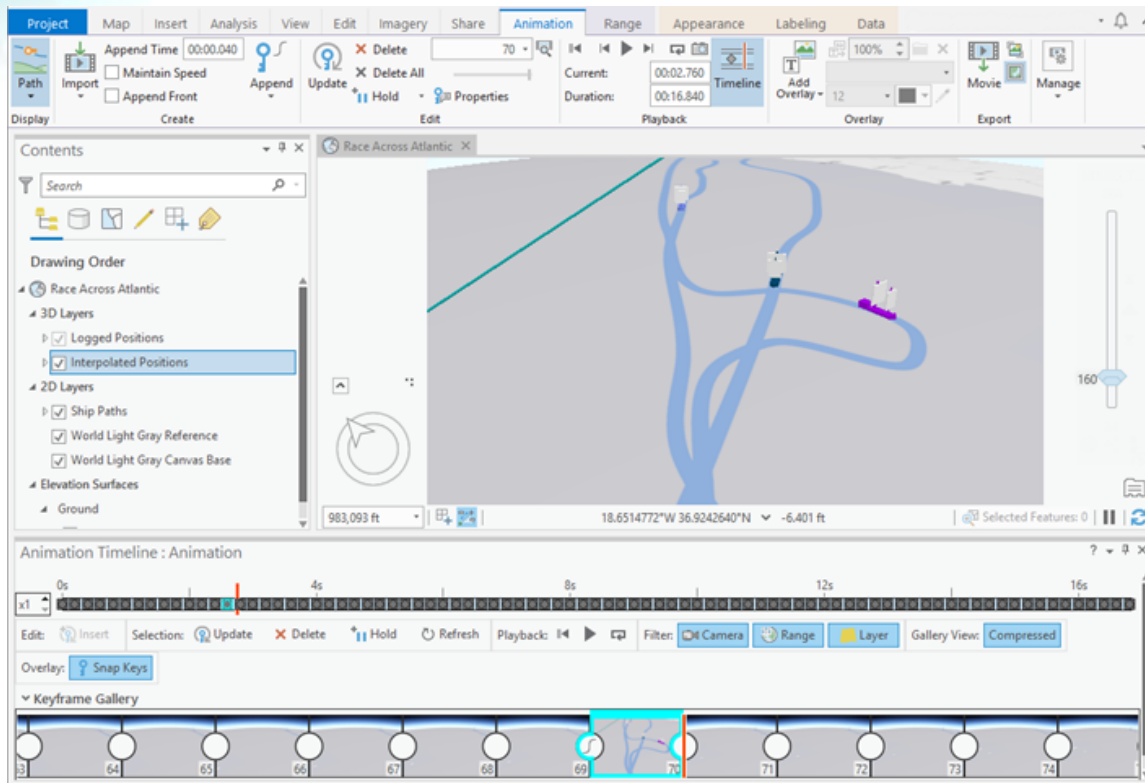
Step 5: Update the intermediate keyframes

You will use bookmarks to update the intermediate keyframes.

Note: It was determined where a vertex was needed in your animation camera path that would keep you in line with the physical path that the ships took, and bookmarks were created for those intermediate keyframes. If the ships had gone more directly between the start and end port, you would need fewer intermediate vertices.

- a** In the Animation Timeline pane, scroll through the frames until you see keyframe 70.
- b** Zoom to keyframe 70 to move to that part of the animation.
- c** Zoom to the At 70 bookmark, and then update the keyframe.

Hint: From the Animation tab, in the Edit group, click the Update Keyframe button.



Now you will repeat these steps for keyframe 150.

- d** In the Animation Timeline pane, locate and zoom to keyframe 150.
- e** Zoom to the At 150 bookmark, and then update the keyframe.
- f** Repeat the previous two steps for keyframe 250.

Next, you will confirm the updated camera flight path.

- g** Zoom to the Racetrack bookmark.



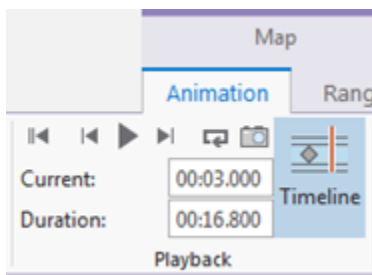
The camera path now follows the path of the ships.

- h** From the Animation tab, in the Display group, click Path to turn it off.

Note: The Path button will be gray when it is off.

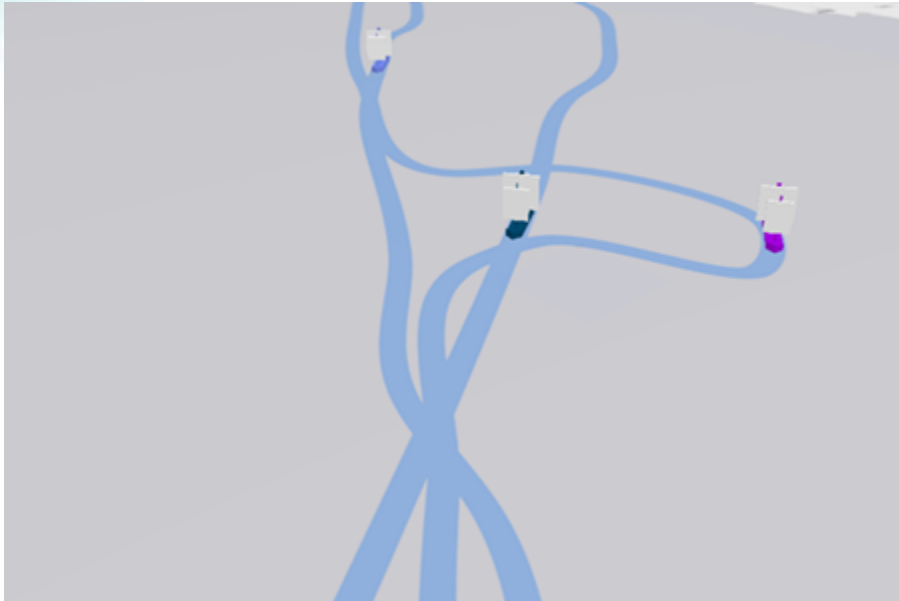
The camera will now fly along ahead of the ships as they race around the earth. You can confirm a few places along the route to preview how the animation will play.

- i** From the Animation tab, in the Playback group, set the Current field to **00:03.000** seconds and press Enter.



- j** Then, set the Current field to **00:07.000** seconds and press Enter.
- k** Finally, set the Current field to **00:09.000** seconds and press Enter.


The camera path stays ahead of the ships and provides a helpful viewpoint to observe their progress.



Camera viewpoint at 3 seconds

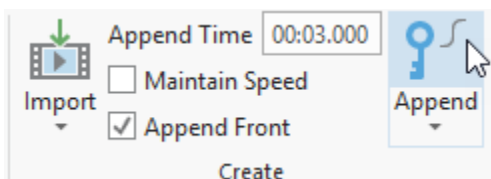
Step 6: Add lead-in and lead-out sections

Next, you will add a 3-second lead-in animation to provide context for the starting point of the race.

- a From the Animation tab, in the Playback group, click the Reset button  to reset the animation to the beginning.
- b From the Animation tab, in the Create group, set the Append Time to 3 seconds (00:03.000), and then check the box for Append Front.

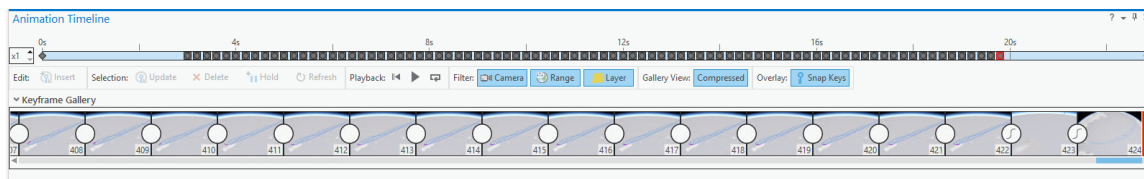
This will append, or add, 3 seconds to the start of the animation.

- c Zoom to the Overview bookmark.
- d From the Animation tab, in the Create group, click Append.



It is also useful to show the full extent of the race after it has been completed. You will add a 3-second lead-out section at the end of the animation.

- e In the Animation Timeline pane, scroll through the frames until you see the last keyframe (now 423).
- f Zoom to keyframe 423 to move to that part of the animation.
- g From the Animation tab, in the Create group, uncheck the Append Front box.
- h Zoom to the Racetrack bookmark.
- i From the Animation tab, in the Create group, click Append.

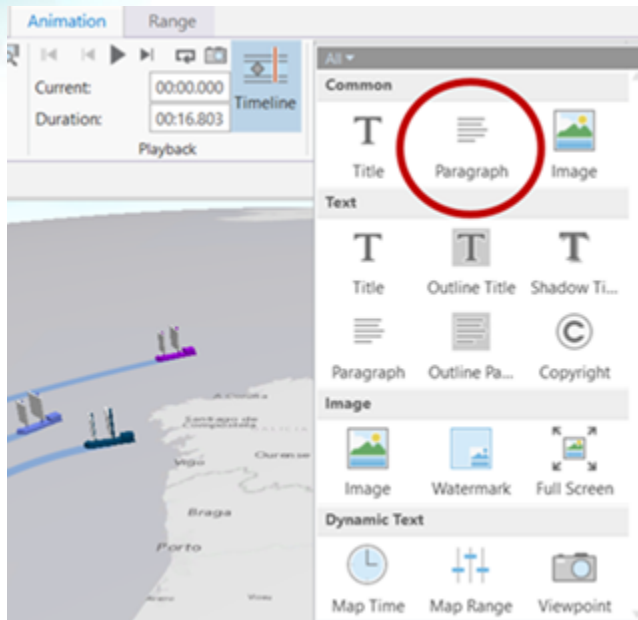


Your stop-motion animation now has 3 seconds of lead-in time and 3 seconds of lead-out time that help the viewer see the full extent of the race. A light blue block in the Animation Timeline pane represents the lead-in and lead-out.

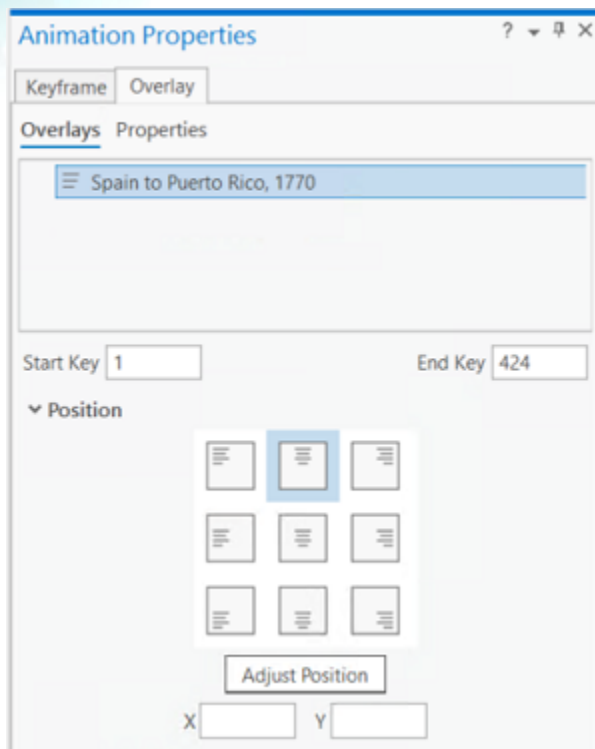
Step 7: Add title text and an overlay image to identify the racing ships

It would be useful for your video to show who was racing and when. You can add overlays to do this.

- a In the Animation Timeline pane, select keyframe 424.
- b Scroll the keyframe gallery all the way to the left so that you can see keyframe 1 in the timeline.
- c Press Shift and click keyframe 1 to select all the keyframes in the animation, from keyframe 1 through keyframe 424.
- d From the Animation tab, in the Overlay group, expand the gallery, if necessary, and click Paragraph.



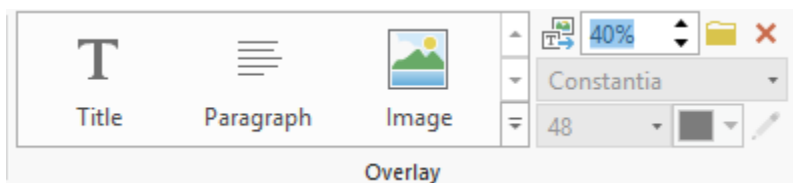
- e In the paragraph text box that opens, type **Spain to Puerto Rico, 1770**.
- f In the top-right corner of the map window, click the red X to close the paragraph text editing mode.
- g Update the font properties to Constantia, 48-point, Arctic White.
- h From the Animation tab, in the Edit group, click Properties.
- i In the Animation Properties pane, click the Overlay tab and set the Position to top center.



Note: The overlay's Start Key and End Key should be 1 to 424, respectively, to show for the entire video.

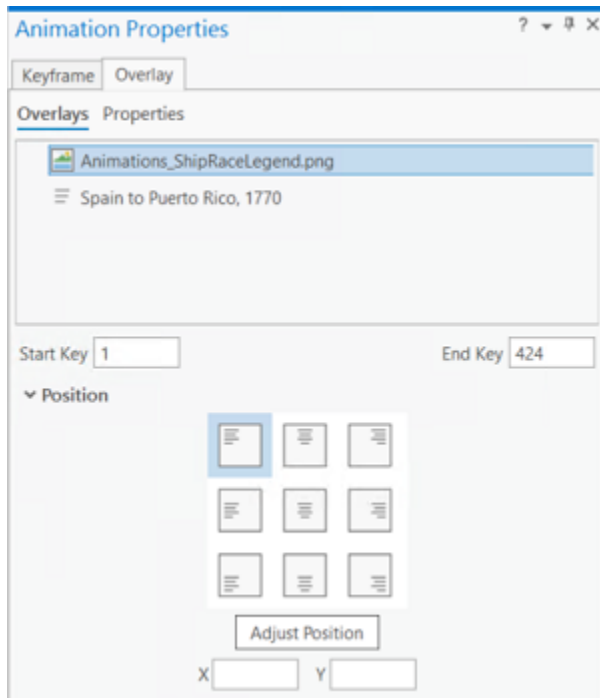
Next, you will add an image to your overlay. All the keyframes should still be selected.

- j** From the Animation tab, in the Overlay group, expand the gallery, if necessary, and click Image.
- k** Browse to the folder where you downloaded the exercise data files, select the Animations_ShipRaceLegend.png file, and click Open.
- l** In the Overlay group, set the Scale to **40%** and press Enter.



- m** In the top-right corner of the map window, click the red X to close the image editing mode.

- n In the Animations Properties pane, select the Animations_ShipRaceLegend.png element and set the Position to top left.



The overlay includes the image on the left and will display for the duration of the video.




- o Save your project.

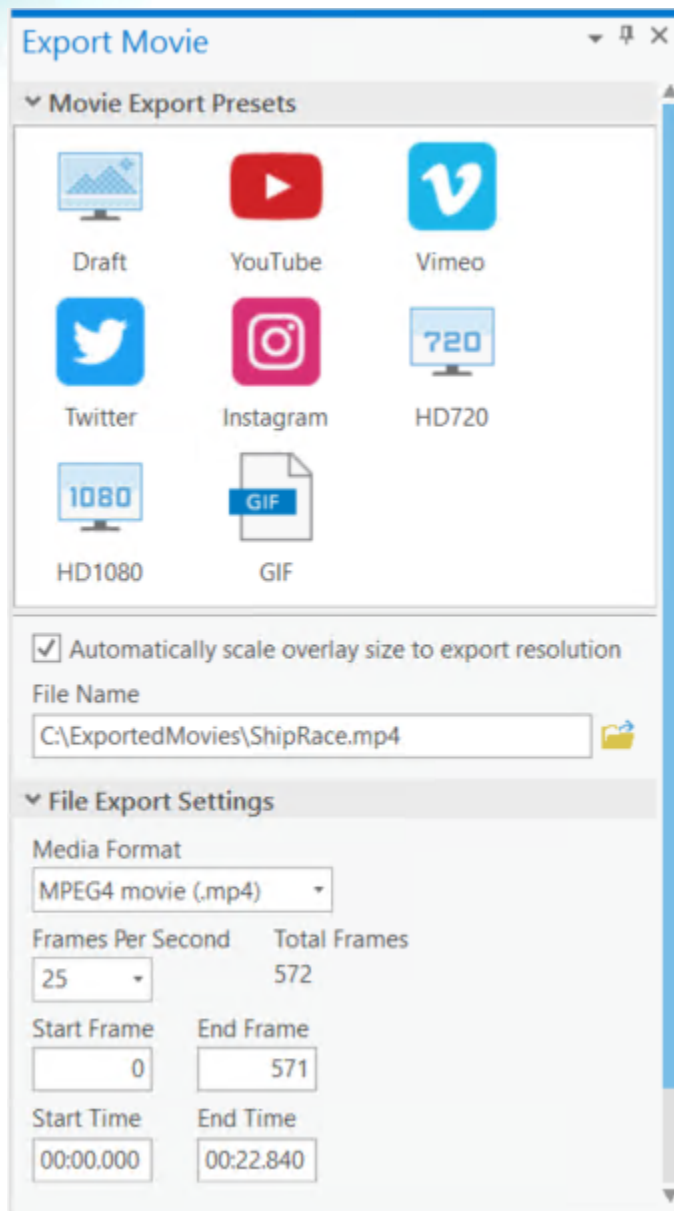
- p** Close the Animation Properties pane.

Step 8: Export the video

Your animation is now ready for export to video. Remember that you will need to set the export frame rate to match your stop-motion rate of 25 frames per second, which you defined earlier in this section.

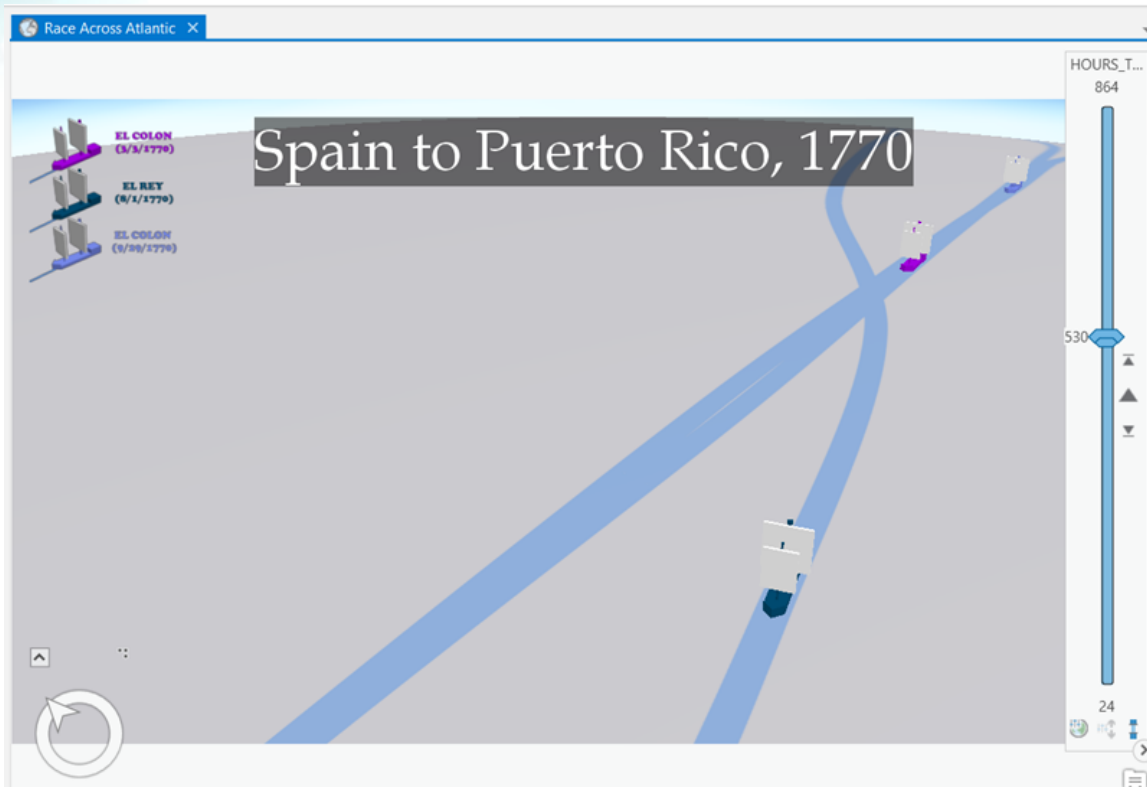
Note: The frame rate is the number of frames displayed per second (fps) in a video. The frame rate has a significant effect on the overall file size. Lowering the frame rate of your video can reduce the file size significantly. However, reducing the frame rate may affect the smoothness of the playback. For this video, you are using a rate of 25 frames per second, which is fast enough that the video looks good but not so high that the output file size is too large.

- a** From the Animation tab, in the Export group, click Movie.
- b** In the Export Movie pane, click the Browse button  and specify an output file name, such as **ShipRace.mp4**, and a folder location.
- c** Expand the File Export Settings section and set Frames Per Second to **25**.



d Click Export.

Note: This animation will take longer to export than the previous ones because the content changes in every frame. The time estimate will be shown at the bottom of the Export Movie pane.



- e When the export has completed, at the bottom of the Export Movie pane, click Play The Video.

Optional: If you have a YouTube account, sign in to YouTube and post the video.

If you would like to compare your final map to the author's, you can open the Animations_Complete_RaceAcrossAtlantic.mpkx file in the VideoResults folder on your computer where you extracted the exercise data files.

- f Save your project, and then exit ArcGIS Pro.

Conclusion

There are many other capabilities available with animation. For example, you can set the transition type between keyframes to linear, fixed curve, hopped, and stepped, or you can use the scene's lighting to cast shadows through time. So, spending more time reading the ArcGIS Pro Help on [animation documentation \(https://bit.ly/2qrYfz5\)](https://bit.ly/2qrYfz5) or watching [ArcGIS Pro animation instructional videos \(https://bit.ly/2EBHbvp\)](https://bit.ly/2EBHbvp) is recommended.

One element of video construction not covered in this exercise is the audio component. ArcGIS Pro does not include the ability to add audio into your videos yet, so post-production

work using third-party software, such as TechSmith Camtasia, GoPro, or Windows Movie Maker, would be required. If you have the time and resources to do so, audio can be extremely effective at providing detailed information, such as a narrated explanation of the content. It can also add mood and ambience, such as an appropriate background soundtrack.

Whatever GIS story you want to tell, animation is a powerful way to get your message out to a diverse range of people. Good luck animating!

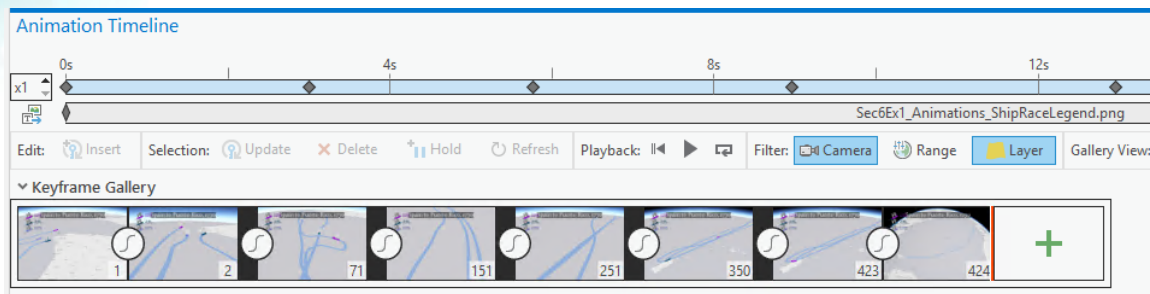
Stretch Goals

- If you are feeling adventurous, you can return to Step 4 and Step 5 of the Race Across Atlantic scene and update the keyframes with camera properties to create a video where the camera tracks the ships from behind, the side, or above.

Note: A keyframe captures and stores the state of the camera as it is created. These properties include the camera's position (X, Y, and Z) and viewing direction (heading, pitch, and roll), and they can be updated individually in the Animation Properties pane on the Keyframe tab. Refer to ArcGIS Pro Help to learn more about the [Animation Properties pane](https://bit.ly/2GNrSpw) (<https://bit.ly/2GNrSpw>).

- You could also include additional features into the Race Across Atlantic scene, such as marker buoys that show the leading point after days 5, 10, 15, 20, and 25, or perhaps lines indicating the distance from the Spanish coast or the distance remaining to Puerto Rico. Many potential videos can be created from this one scene—and you are the director!

Hint: The Animation Timeline pane allows you to filter out which keyframes are displayed in the gallery based on what properties that they contain. If you uncheck the Range option, you will only see keyframes that have Camera properties. In your case, that would be keyframes 1, 2, 71, 151, 251, 350, 423, and 424. (When you added a keyframe at the start in Step 6, the intermediate keyframes that were updated earlier—like 70 and 150—were pushed back by one.) This makes it simpler to fine-tune a specific subcomponent of your video.



Use the Lesson Forum to post your questions and observations. Be sure to include the **#stretch** hashtag in the posting title.