


# Animating a historical ship race

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## Time: 40 minutes

## Overview

Content is all about telling a story. Whether it's a story about analysis results, a disaster, or maybe even land use changes, your main goal as a GIS analyst is to share a message that informs, compels, persuades, and convinces your audience to act.

Sharing GIS knowledge does not always require an interactive online scene; it can also be done with an animated video, which is a rich, engaging medium that is cost-effective, easy to manage and create, and will help convey your message.

With animated videos, you're free to do whatever you want. Let your imagination run wild! The medium gives you the ability to bring any concept, no matter how complex or simple, to life with ease.

In this lesson, you will create a video depicting a simulated virtual sailing ship race from 1770 by plotting the logged positions of the ships as they crossed the Atlantic from La Coruña, in Spain, to San Juan, in Puerto Rico.

In this lesson, you will learn to do the following:

- Create a stop-motion style video to simulate feature movement
- Add on-screen text to provide additional information
- Use dynamic overlay text to embed the map's date/time into the video

## About

From the earliest days of deep-sea sailing, mariners have kept logbook accounts of their voyages. By 1750, the keeping of logbooks was almost universal among the officers of European ships. Although not prepared with this purpose in mind, the logbooks and the detailed observations that they contain are of great scientific value today.

Thanks to the CLIWOC database built from official captains' shipping logs, we know that in 1770 there were three sailing ship journeys made from La Coruña, in Spain, to San Juan, in Puerto Rico. The ship El Rey did it once, in August, and the ship El Colon made the trip twice, in April and October.

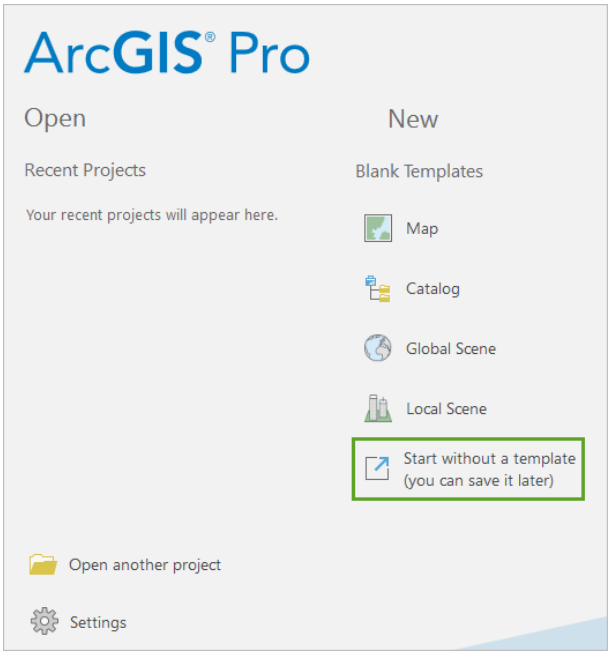
Although these ships left port on different days, we can normalize the data in such a way that instead of using actual departure dates, we use "hours since they left port" to create an animation to compare their progress. In this way, we can simulate a virtual sailing ship race from 1770.

## Getting started

The content for this lesson is contained in a map package. First, you need to create a project using the Blank project template, then import the map packages.

1. Download the **ShipRace.zip** compressed folder.

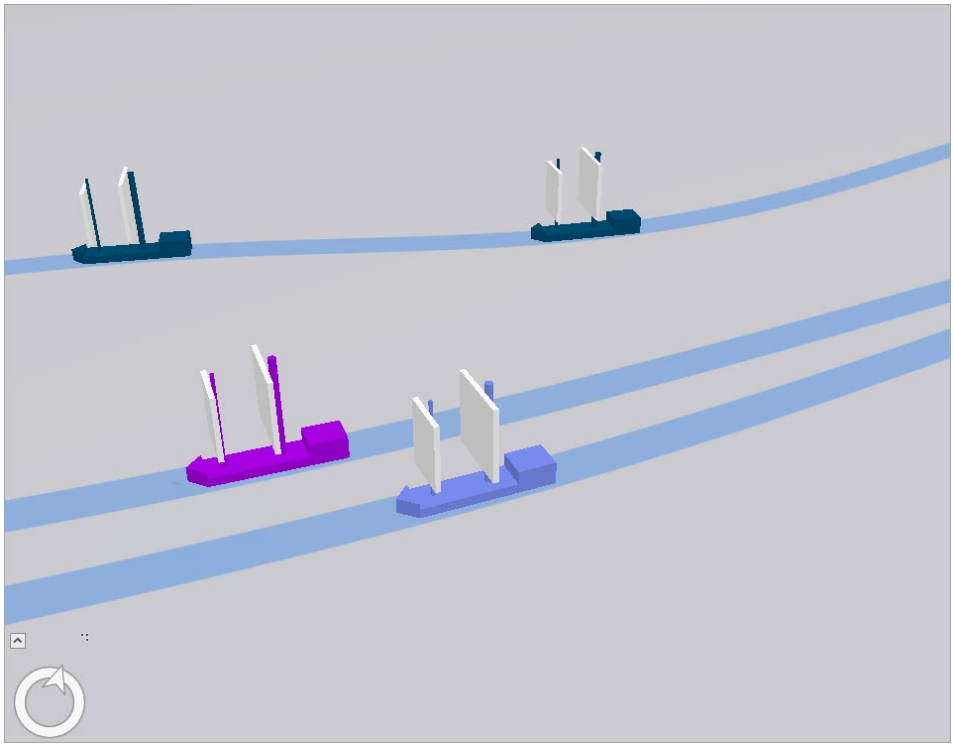
2. Locate the downloaded file on your computer and extract it to a location you can easily find, such as your Documents folder.
3. Start ArcGIS Pro and under **New**, click **Start without a template**.




Note: If you don't have ArcGIS Pro or an ArcGIS account, you can sign up for an ArcGIS free trial.

4. On the Quick Access toolbar, click Save or press Ctrl+S to save your project.
5. In the **Save Project As** window, accept the default storage location and save the project as " **ShipAnimation** ".
6. On the **Insert** tab, in the **Project** group, click **Import Map**.
7. Browse to the location where you stored your download data or search for **ShipRace.mpkx** to import this scene and click **OK**.

A scene named Race Across Atlantic opens to display a 2D layer representing ship paths and 3D layers representing logged and interpolated ship positions.



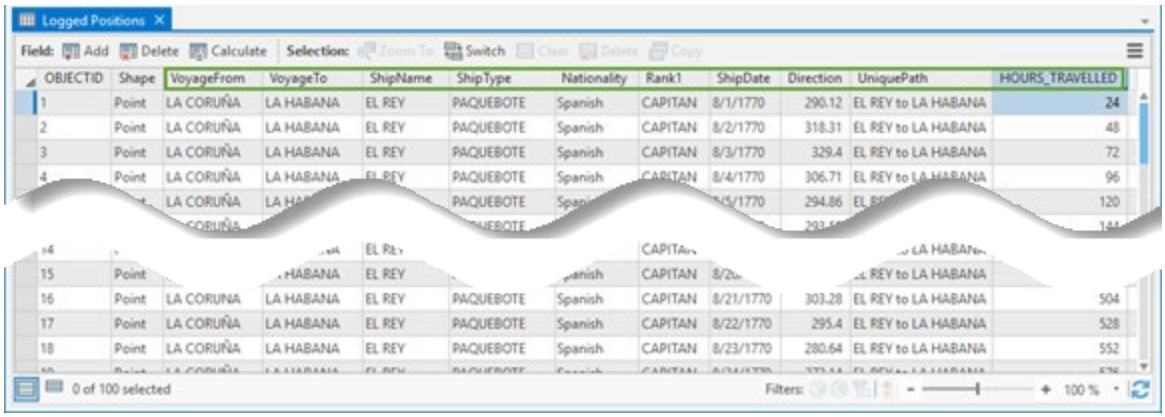
## Reviewing the data

A quick review of the data, which has been pre-generated for you, will help you understand the animation settings required to create a video illustrating the virtual sailing ship race from 1770.

You will create the video using the hours from port field to animate the positions of the ships across the Atlantic. This technique is stop-motion, which is what's used in a flip-board animation, or a computer-generated movie (such as "Toy Story"), or claymation (such as "Wallace & Gromit"). This technique requires a single feature location and orientation for each output video frame, where the action of replaying them one after another gives the impression of movement.

1. In the **Contents** pane, click on **Race Across Atlantic** to activate the scene.

2. Right-click **Logged Positions** and select **Attribute table**.



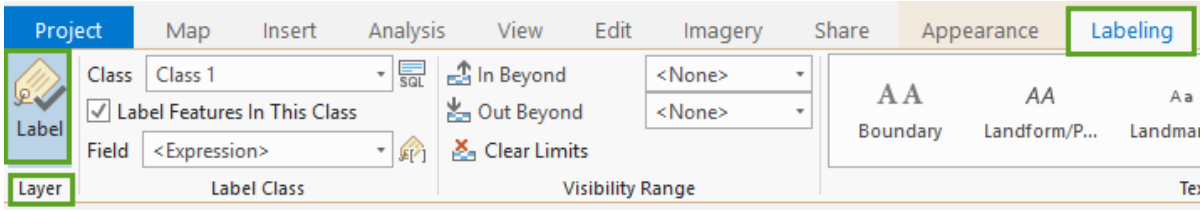

Spend a few minutes reviewing the **Logged Positions** attributes. These are the officially recorded ship locations, per the transcribed historical logbooks for these ships.

3. Review the **HOURS_TRAVELLED** field and note how the values represent the number of hours travelled away from the port of origin and toward the destination.

4. When you are done, close the attribute table.

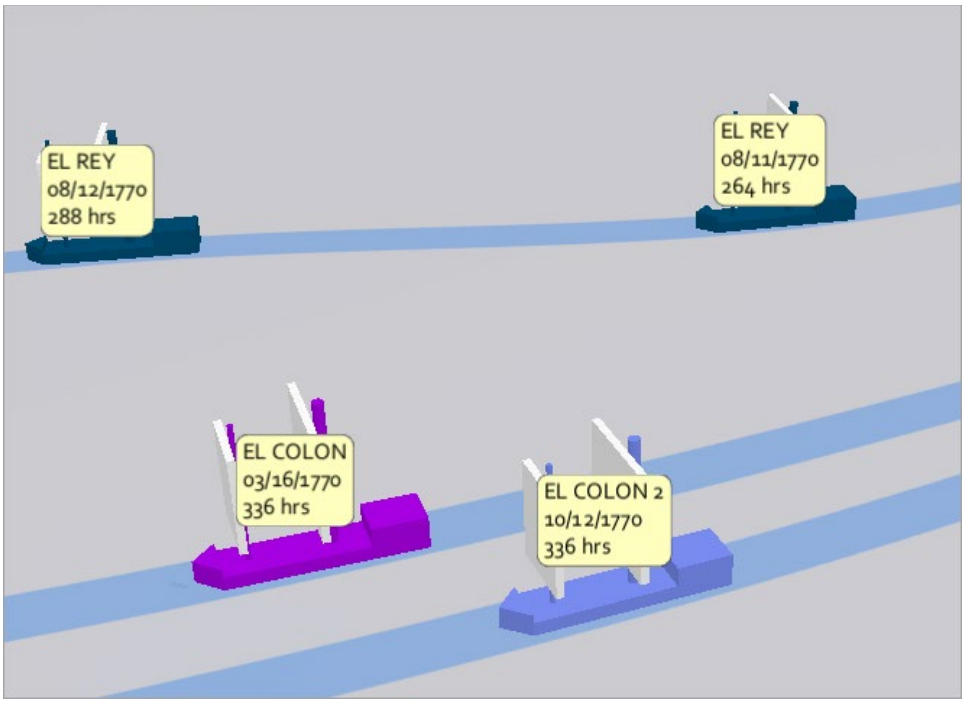
5. In the **Contents** pane, click **Logged Positions** to select the layer.

6. On the ribbon, in the **Labeling** tab, in the **Layer** group, then click **Label**.



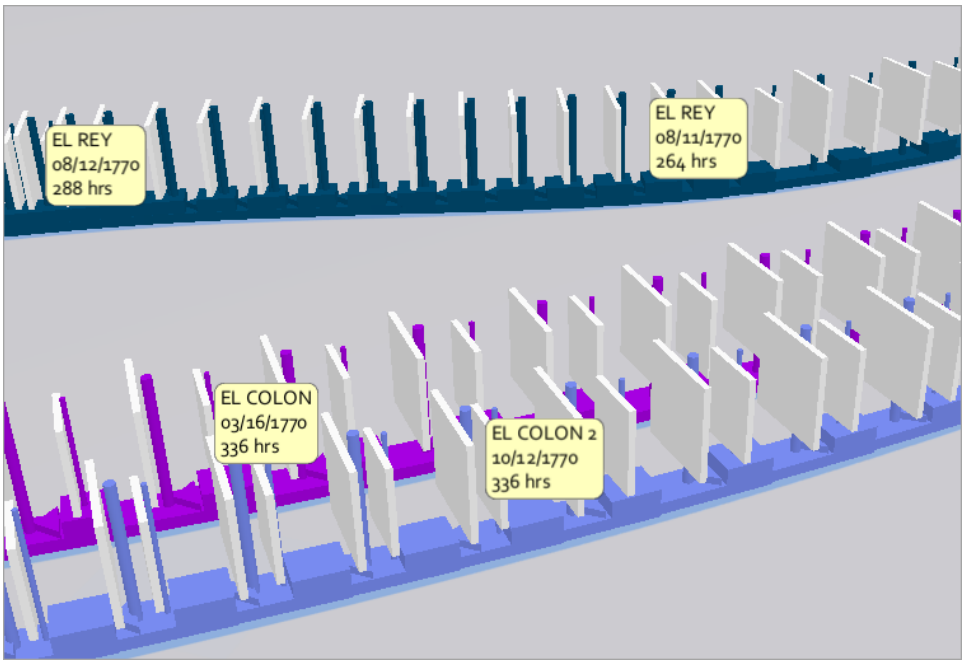

The view updates to display labels for the selected layer. The label properties have been configured to display the ship's name, log date, and hours from port of origin.

Notice, that the El Rey has a 48-hour lead at this point.



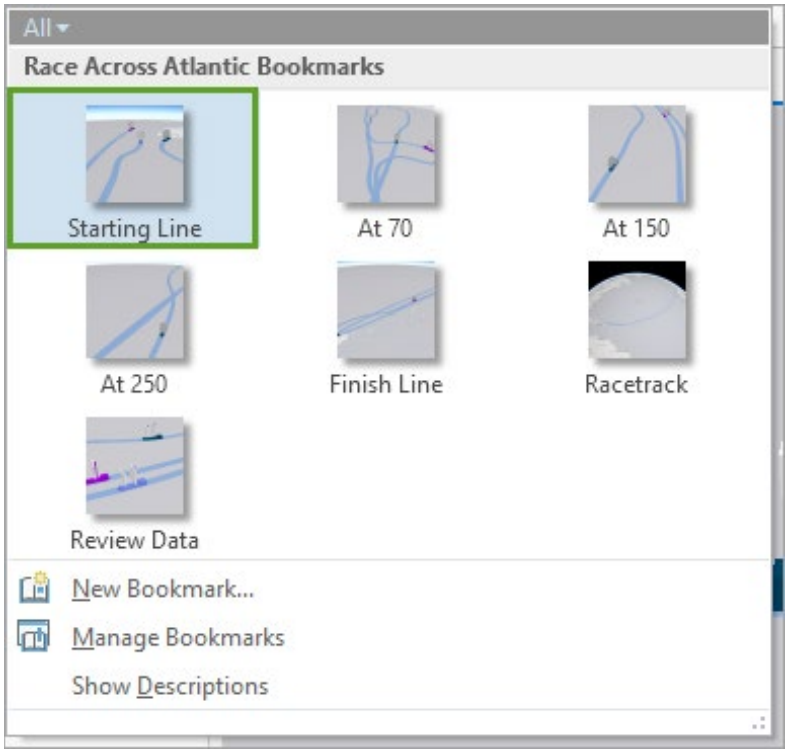

7. In the **Contents** pane, check the **Interpolated Positions** layer.

Twelve intermediate (estimated) ship positions have been calculated on a smooth curve between the known locations. This means each ship symbol represents a two-hour interval.

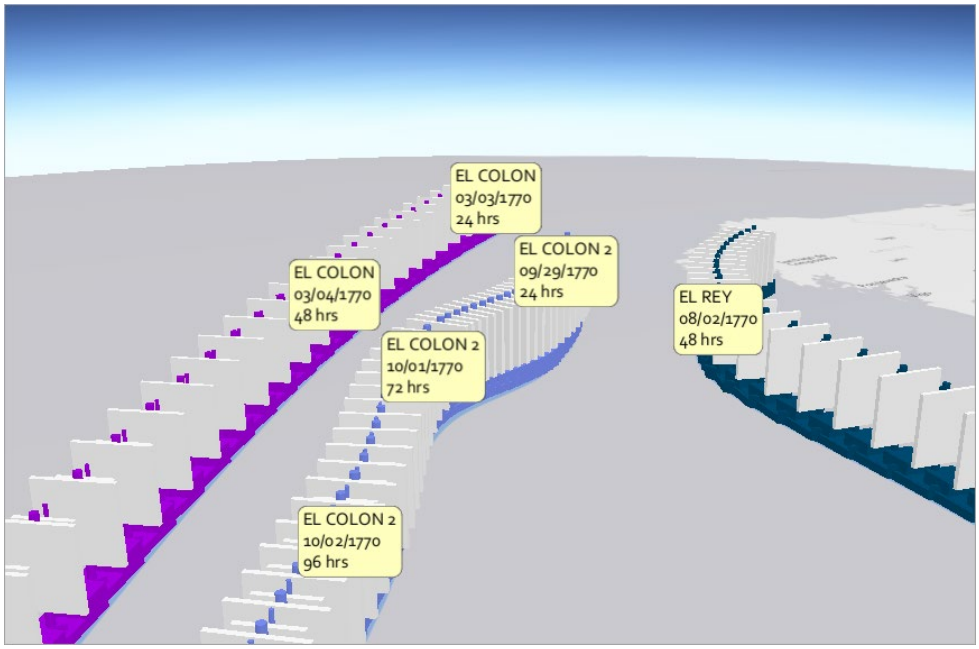



Displaying each of these points in order–that is, using stop-motion display–will create the illusion of movement in the video.

8. On the ribbon, click the **Map** tab, in the **Navigate** group, expand the **Bookmarks** gallery, and click **Starting Line**.




The view updates to display both the logged and interpolated positions from the start position in La Coruña, in Spain.



9. On the **Labeling** ribbon, click **Label** to hide the labels for the **Logged Positions** layer.

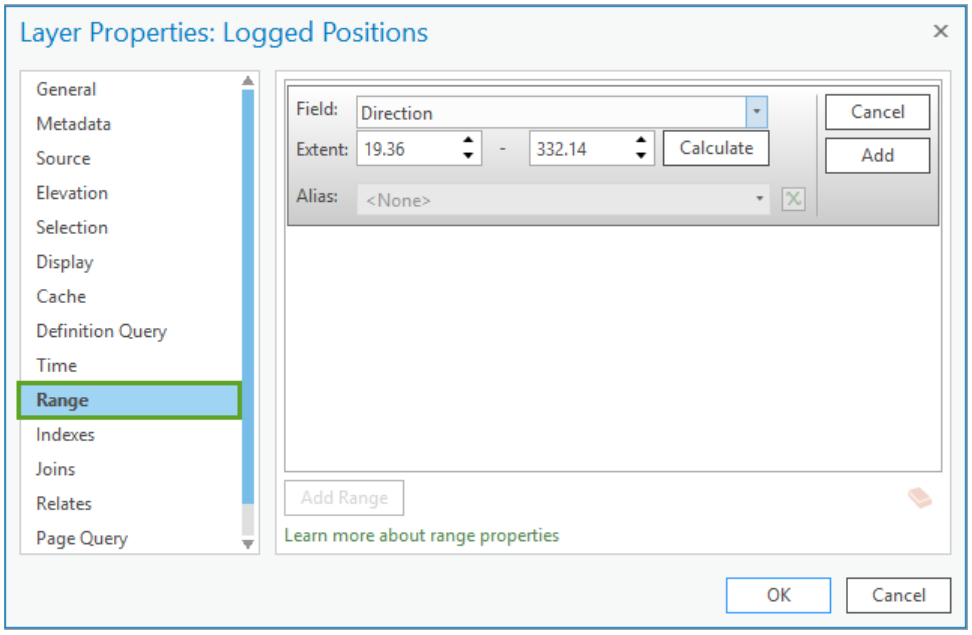
On a general cartographic note–each ship is shown as 30 kilometers high, so the symbols can be seen over the large distances being travelled, and the Ship Paths line layer is 14 kilometers wide, which represents the approximate distance that can be seen across the ocean from a mast height of 15 meters/50 feet.

## Filtering content by range

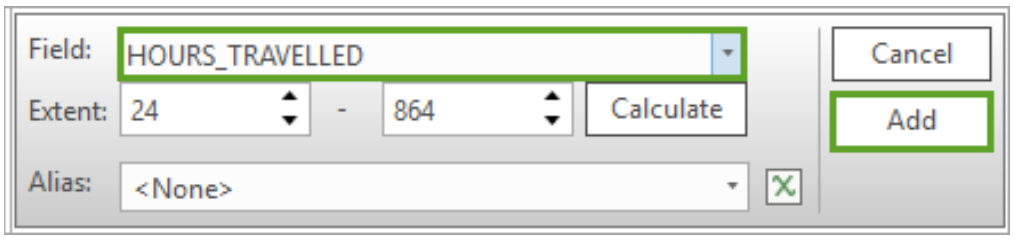
Range filtering can be applied to any numeric field in a layer and can be applied to multiple layers in the view. For our stop-motion video, we need to view features with specific hours travelled, at a specific rate and in a specific order, which is a good match for this tool.

1. In the **Contents** pane, right-click **Logged Positions** and click **Properties.**

2. In the **Layer Properties** dialog box, click **Range** , then click **Add Range**.




3. For Field, choose **HOURS_TRAVELLED** from the drop-down list, and click **Add.**




4. Click **OK** to close the **Layer Properties** dialog box.

5. In the **Contents** pane, right-click **Interpolated Positions** and click **Properties**.

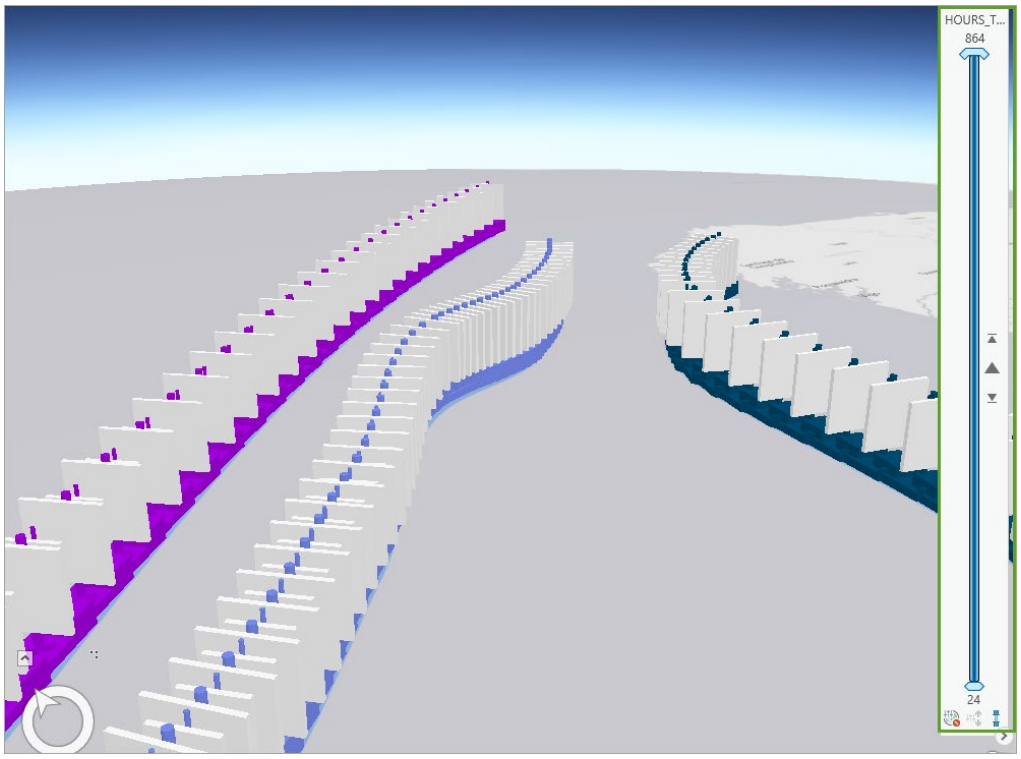
6. In the **Layer Properties** dialog box, click the **Range** tab, and click **Add Range.**

7. Choose the **HOURS_TRAVELLED** field from the drop-down list and click **Add**.

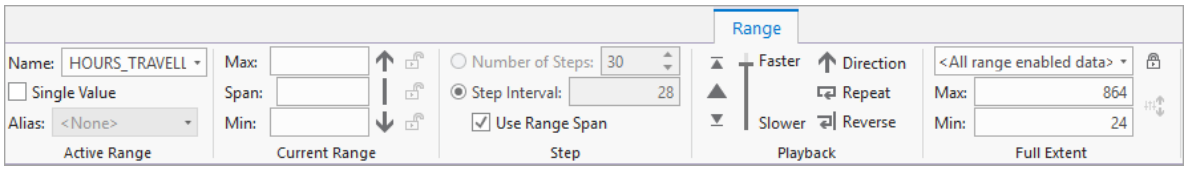



8. Click **OK** to close the **Layer Properties** dialog box.

The view updates to display an on-screen range slider control on the right side of the view. In addition, a range tab has been added to the ribbon.

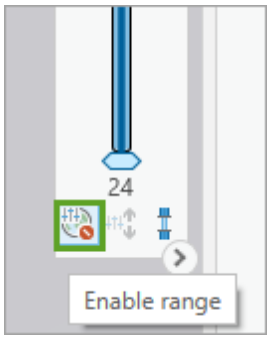



9. On the ribbon, click the **Range** tab to display range functionality and properties for the view.

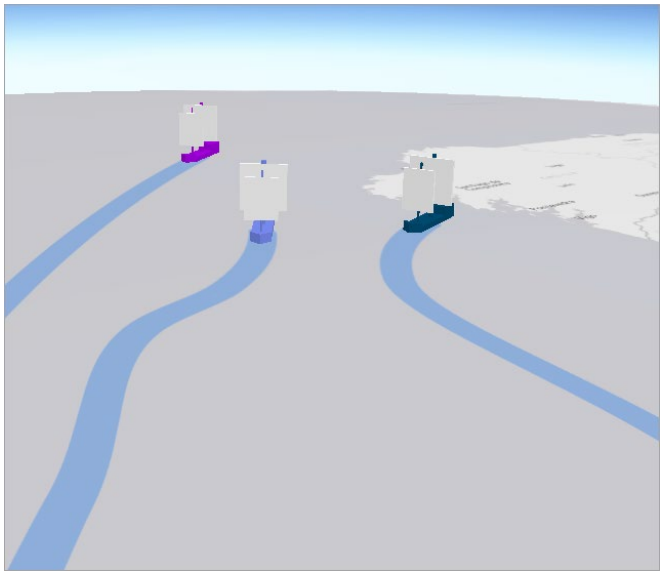



Your scene is now range-aware, but the filter is not being actively applied.

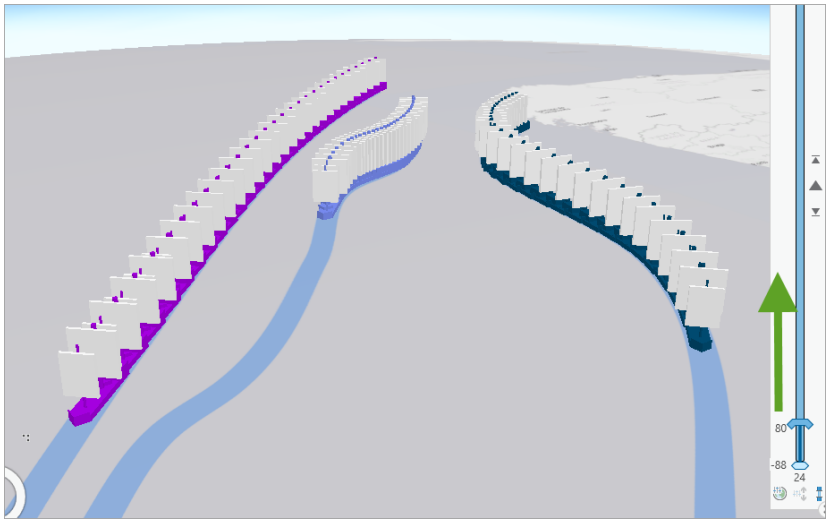
10. Hover over the range slider and click the **Enable Range** button in the lower left corner.



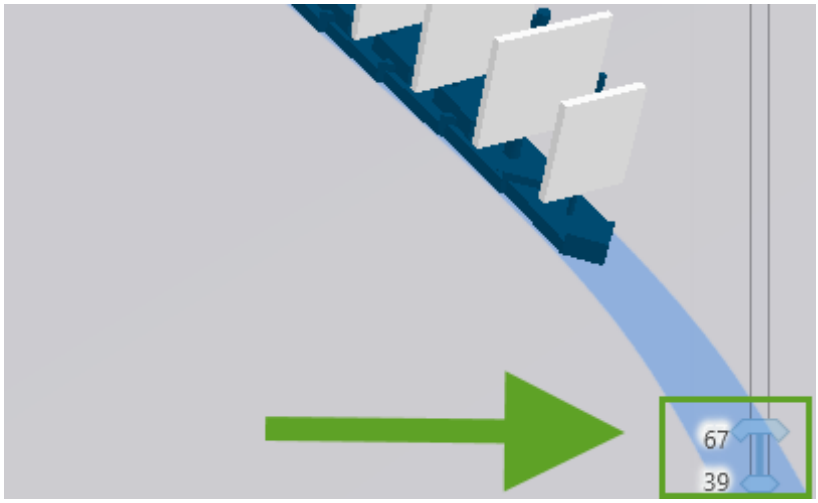

The view updates and displays ships at the starting position; all additional logged and interpolated positions are currently removed but will be displayed as you iterate within the range.



Using the range slider, you can interactively drag upward to update the subset of features that are being displayed.



11. Drag the slider to display a range between 39 and 67 hours travelled from port.



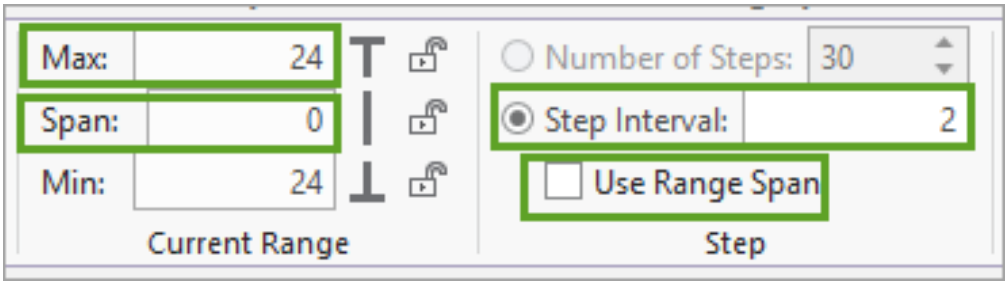

Notice how multiple features are now displayed because they all fit within the current range extent.

**Tip**: You can set the specific values for the scene's current range, and how it should step forward, in the ribbon.

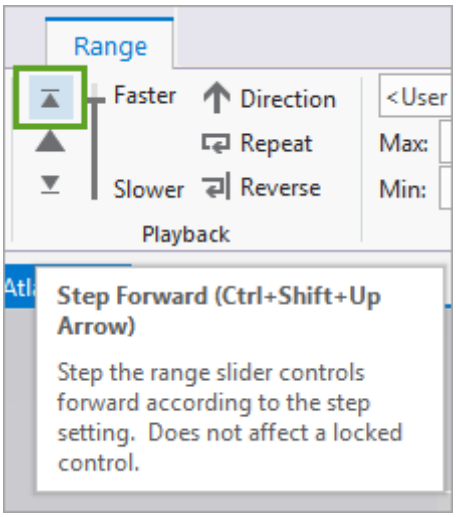
12. On the ribbon, click the **Range** tab.

13. In the **Current Range** group, set:
    - **Min** to **24**
    - **Span** to **0**

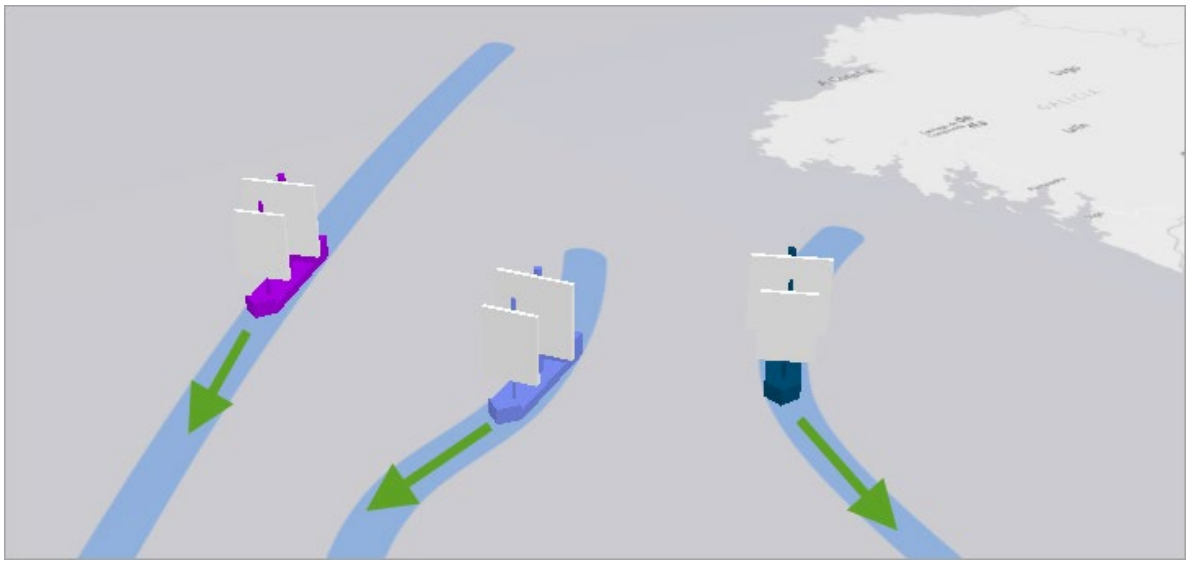
14. In the **Step** group:
    - Set **Step Interval** to **2**
    - Uncheck **Use Range Span**




15. In the **Playback** group, click the **Step Forward** (up) button several times so you can see the ships move with each click.




Along the ship paths, a single ship feature is shown. As you step forward along its path, the feature moves forward along the range.



16. Save the project.

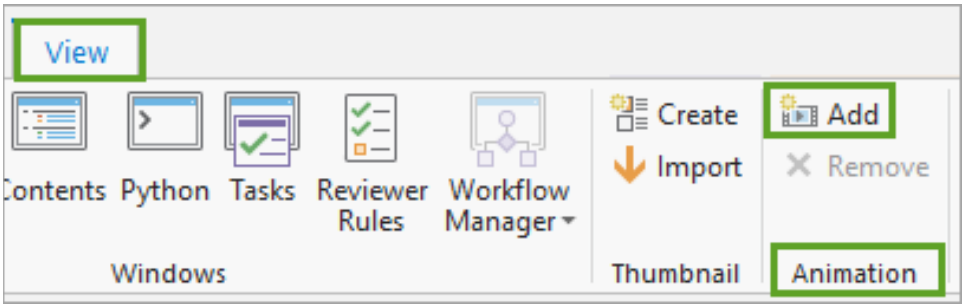
## Using the range definition to create an animation

The range slider is now well configured to be animated. First, you need to add an animation to the scene and zoom to the starting point of your video.

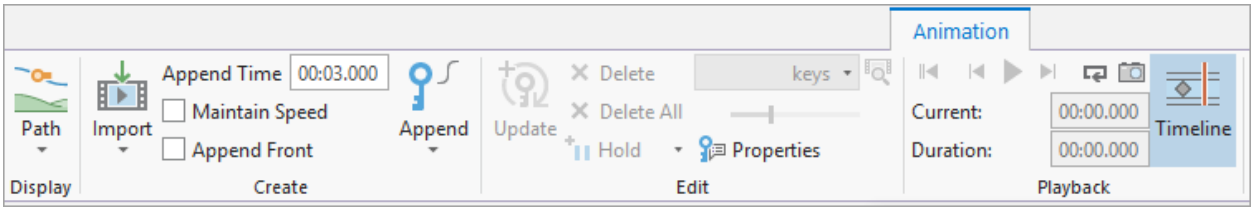
In ArcGIS Pro, videos are the output of an animation, and are most often created as a final step after your maps or scenes are fully prepared. An animation is authored by creating an ordered set of keyframes, where each keyframe contains the current view position, the visibility and transparency of the layers in the

map, and the map's current time and/or range extent. When the animation is exported to a video file, intermediate frames are interpolated between the states captured in your keyframes.

1. On the ribbon, click the **View** tab, in the **Animation** group. Click the **Add** button.



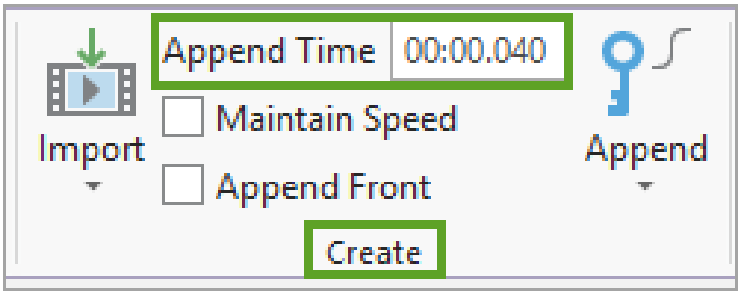

Adding an animation, also displays an Animation contextual tab with groups of tools for the Display, Creation, Editing, and Playback of an animation.




2. On the ribbon, click the **Map** tab, in the **Navigate** group, expand the **Bookmarks** gallery, and click **Starting Line**.

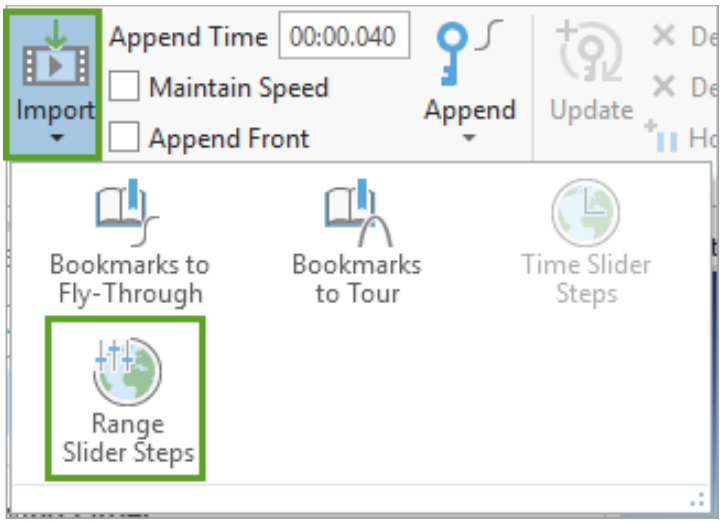
The key step in making a stop-motion video is ensuring you will create a single frame for each feature that will be rendered. To create a 25-frames-per-second video, each individual feature would need to be shown for 0.04 seconds. Before converting your range configuration into an animation, set this as the default keyframe append time in the ribbon.

3. On the **Animation** tab, **Create** group, set the **Append Time** to 0.04 seconds

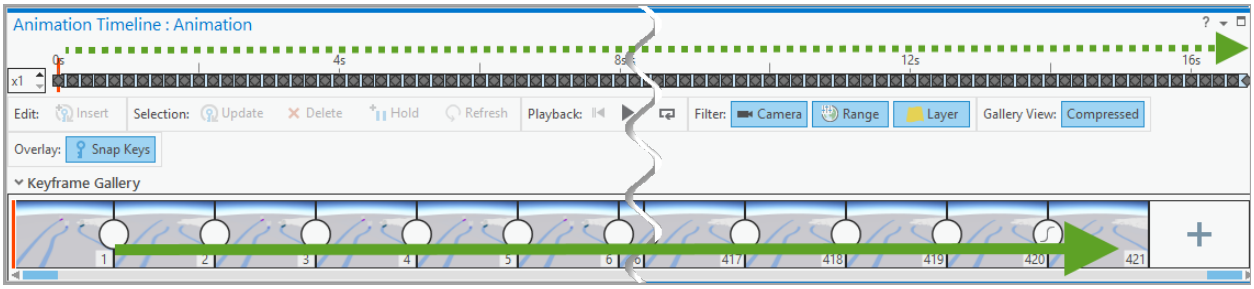



4. On the **Animation** tab, in the **Create** group, expand the **Import** gallery.

5. Click **Range Slider Steps**.



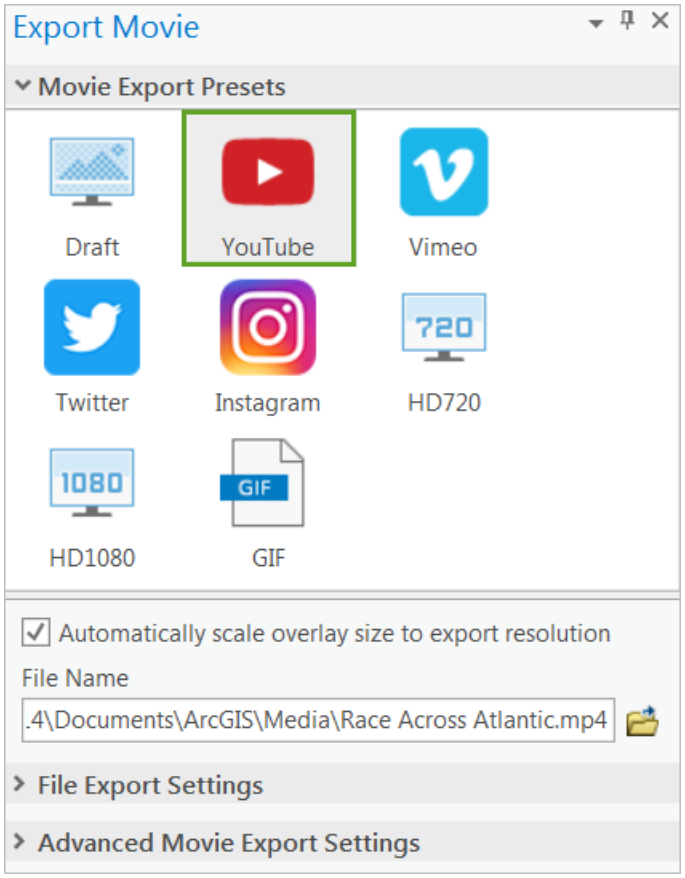

This will create an animation with 421 keyframes, one for each two-hour step through the range slider. The current total playing time for your animation is now 16.8 seconds.




The end goal for this animation is to share the virtual boat race on YouTube, so you need to update the output format, to preview the display with the appropriate aspect ratio.

6. On the **Animation** tab, in the **Export** group, click **Movie** to open the **Export Movie** pane

7. In the **Export Movie** pane, click on the **YouTube** preset option.

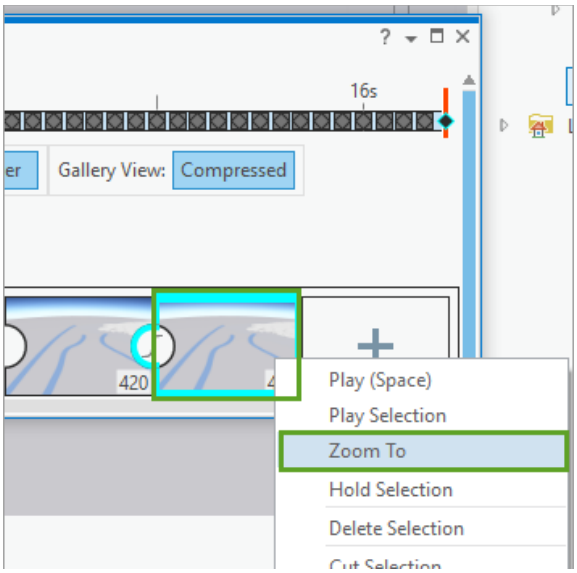



Since this is a different aspect ratio than before, you will notice that the framing of the view has been adjusted.

8. Close the **Export Movie** pane.

9. In the **Animation Timeline**, scroll to the last keyframe, **421**.

10. Right-click keyframe **421** and choose **Zoom To** to move to that part of the animation in the scene.




In the scene, notice that the ships have disappeared.



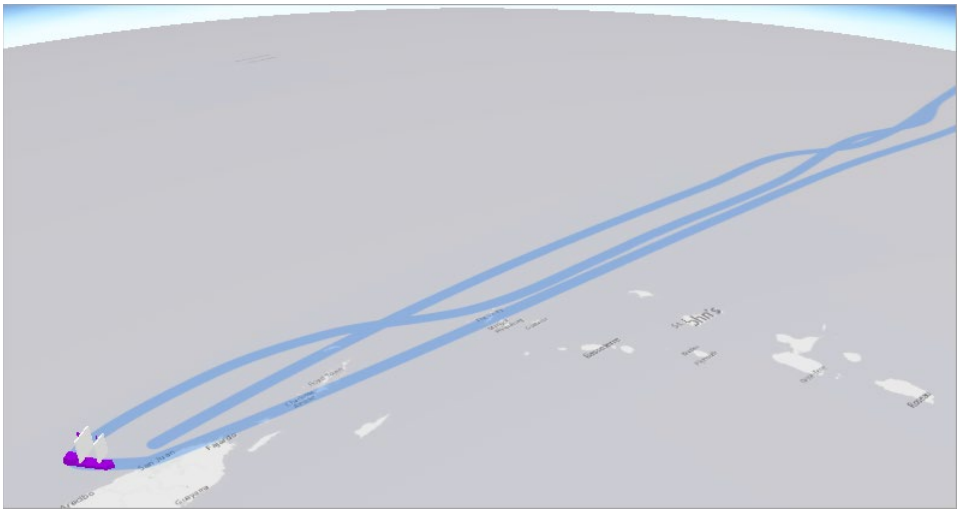

This is because they have travelled past the camera and completed the race. This is how the import of **Range Slider Steps** works; it has no camera details. Since it does not know where you want the camera to move to next, it leaves it in the same place, in this case at the origin point of the ships in Spain.

To remedy this, you need to update some of the keyframes, so the camera knows where to move to keep the racing ships visible.

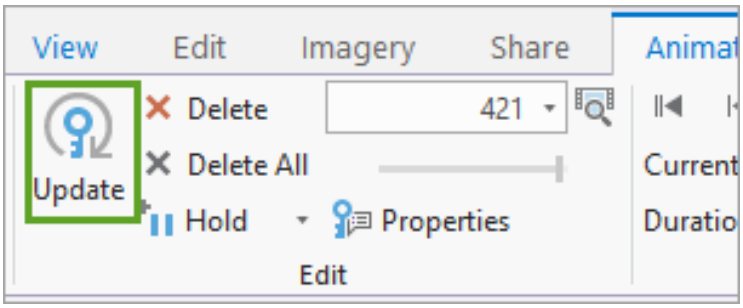
## Update the last keyframe to the race destination

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.

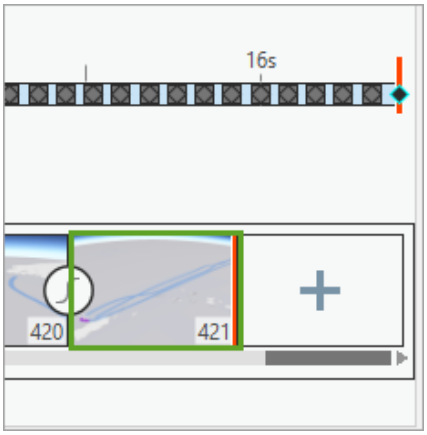
1. On the ribbon, click the **Map** tab, in the **Navigate** group, expand the **Bookmarks** gallery, and click **Finish Line.**



2. On the **Animation** tab, in the **Edit** group, click the **Update** button.




This will update the selected keyframe (keyframe 421) with the destination in San Juan, Puerto Rico.

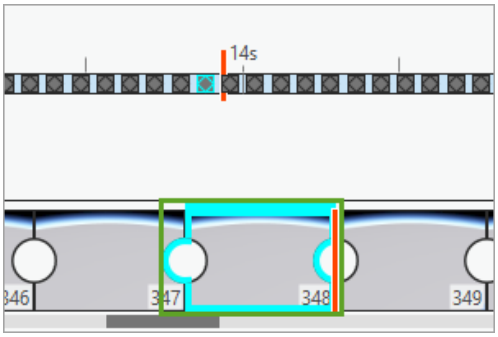



Note that the last keyframe (421) is when the slowest ship arrives. You need the camera to get to the finish line when the fastest ship arrives, and then hold the same viewpoint until all the ships finish.

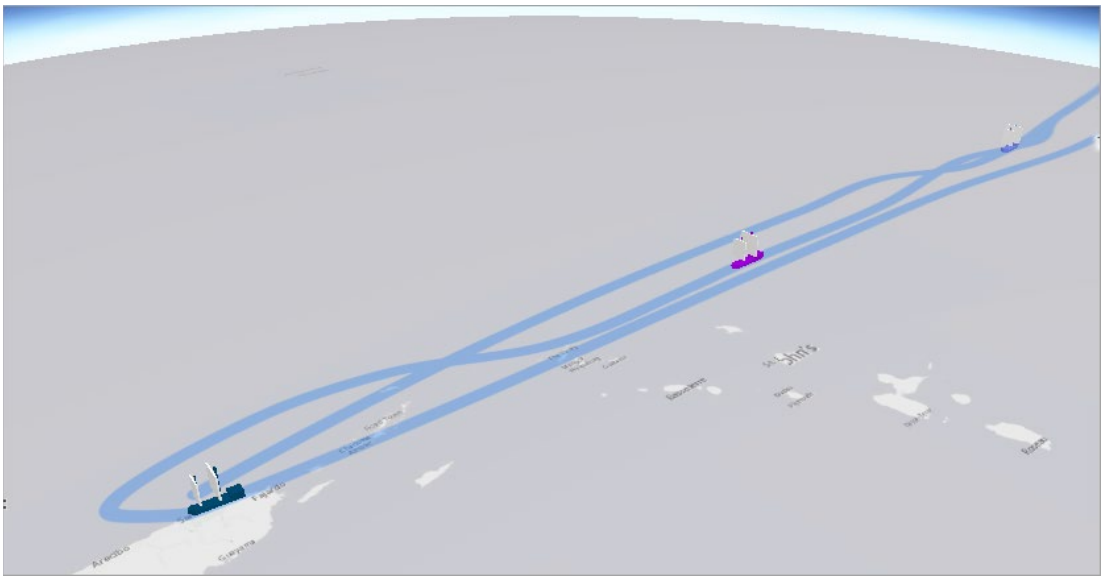
The data tells us that the winner arrives after 29 days of travel, so the arrival keyframe for the fastest ship is #348 (29 days x 12 frames/day).

3. In the **Animation Timeline**, scroll to keyframe **348.**

4. Right-click keyframe **348** and choose **Zoom to** to move to that part of the animation.




5. On the ribbon, click the **Map** tab, in the **Navigate** group, expand the **Bookmarks** gallery, and click **Finish Line.**



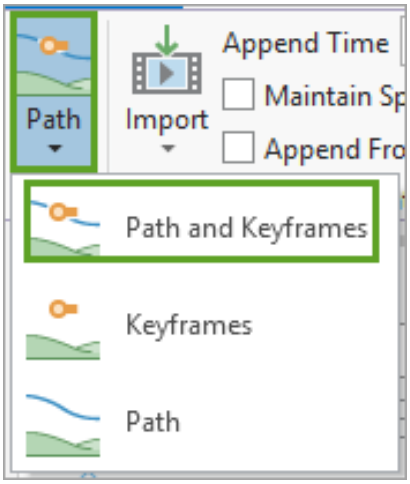
6. On the **Animation** tab, in the **Edit** group, click the **Update** button.

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

7. On the ribbon, click the **Map** tab, in the **Navigate** group, expand the **Bookmarks** gallery, and click **Racetrack**.



8. On the **Animation** tab, in the **Display** group, click **Path and Keyframes**.




You are now displaying the camera's flight path. From this viewpoint, you can see that the ships' paths are curved, and the direct camera flight path between the start and finish (which is what you have now) will not keep the ships in view.



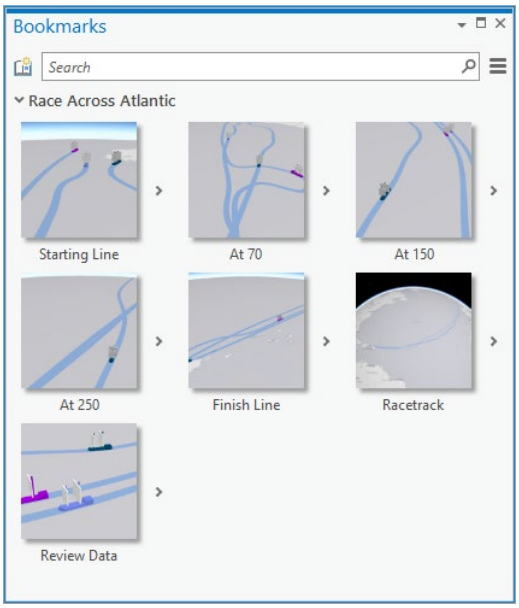

To fix this, some of the intermediate keyframes must also be updated to follow the race more closely.

## Update intermediate keyframe camera locations

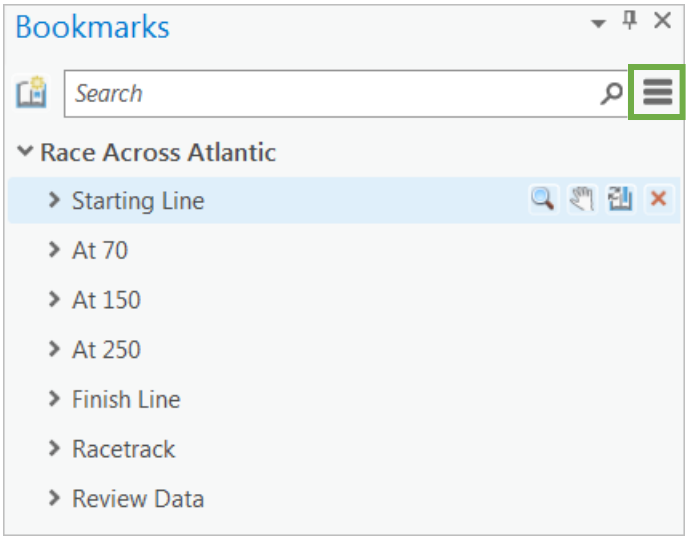
For expediency, a set of bookmarks has been provided to update a small set of intermediate keyframes. These changes will keep the ships in view as they make their way over the globe.

1. On the ribbon, click the **Map** tab, in the **Navigate** group, expand the **Bookmarks** gallery, and click **Manage Bookmarks**.

This will open the **Bookmarks** pane, showing all the bookmarks in the project.



In the bookmarks pane you can modify how bookmarks are displayed, as a list or by snapshot.




2. In the **Animation Timeline**, scroll to keyframe **70.**

3. Right-click keyframe **70** and choose **Zoom to** to move to that part of the animation.

4. In the **Bookmarks** pane, double-click the **At 70** thumbnail.

The view updates to display the ship paths at the 70th frame.



5. On the **Animation** tab, in the **Edit** group, click the **Update** button.

6. In the **Animation Timeline**, scroll to keyframe **150.**

7. Right-click keyframe **150** and choose **Zoom to** to move to that part of the animation.
8. In the **Bookmarks** pane, double-click the **At 150** thumbnail.
9. On the **Animation** tab, in the **Edit** group, click the **Update** button.
10. In the **Animation Timeline**, scroll to keyframe **250**
11. Right-click keyframe **250** and choose **Zoom to** to move to that part of the animation.
12. In the **Bookmarks** pane, double-click the **At 250** thumbnail.
13. On the **Animation** tab, in the **Edit** group, click the **Update** button.
14. On the ribbon, click the **Map** tab, in the **Navigate** group, expand the **Bookmarks** gallery, and click **Racetrack**.
15. On the **Animation** tab, in the **Display** group, and click **Path and Keyframes**.

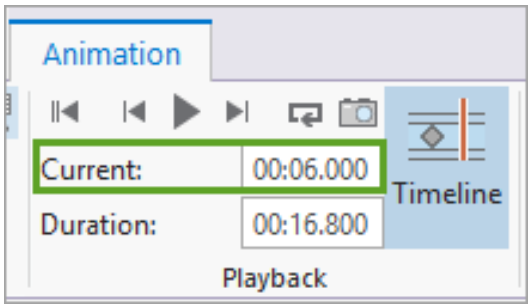
The animation path and the ship paths are now well-aligned.




16. On the **Animation** tab, in the **Display** group, click **Path and keyframes** to switch off the path display.

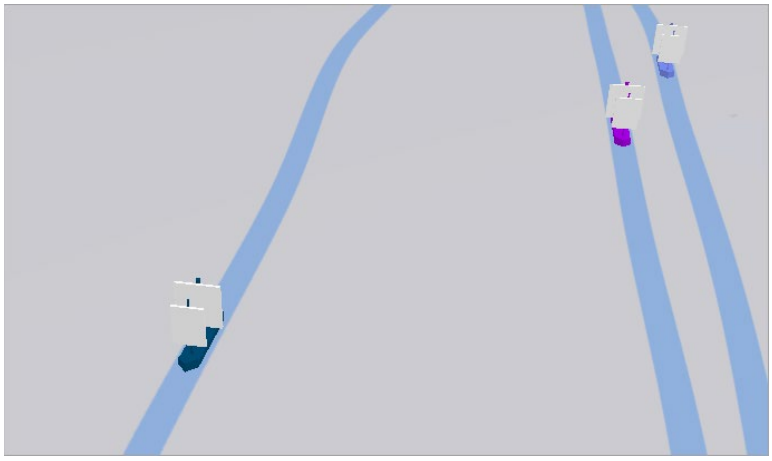
Now let's preview a few places along the route and how they display.

17. On the **Animation** tab, in the **Playback** group, set **Current** to **00:06.000**.



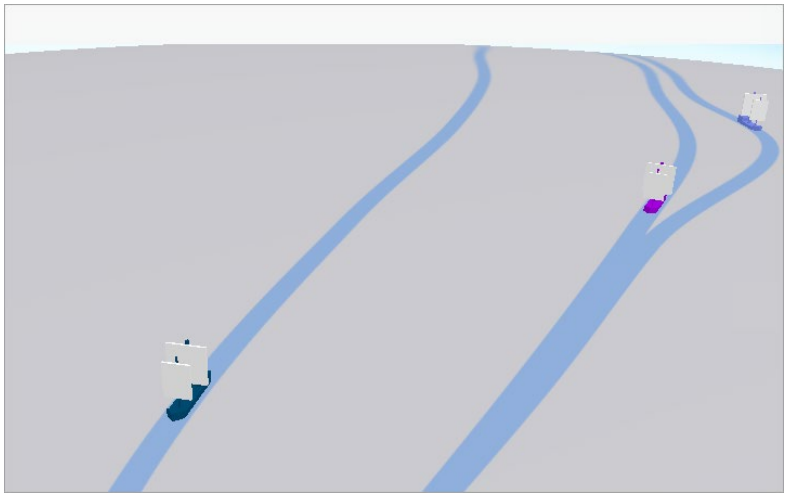

Note the updated scene and the location of the ships.

18. Next, set the **Current** time to **00:07.000**.



Now note the location of the ships.

19. Next, set the **Current** time to **9** seconds.



Did you notice if the ship locations changed–are they currently displayed in the scene?

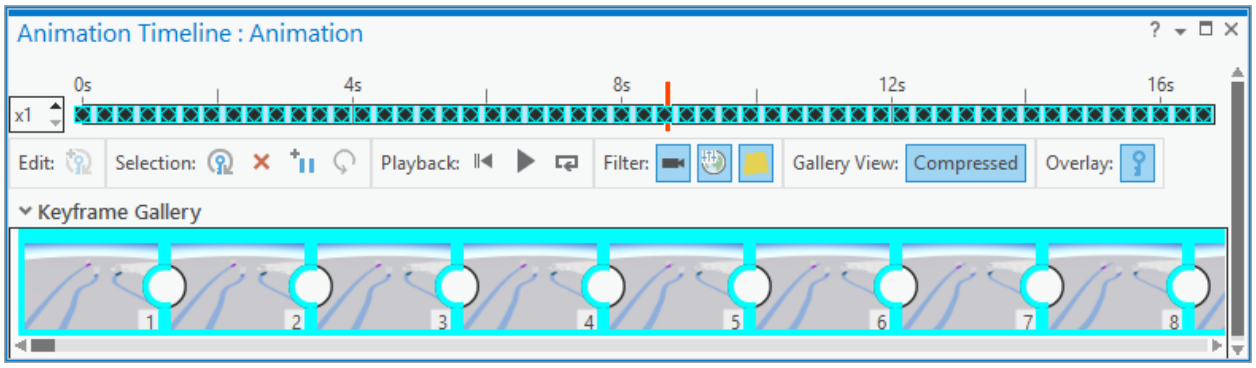
## Adding contextual overlay elements

Your video also needs to show who was racing, and when. You can add overlays to do this.

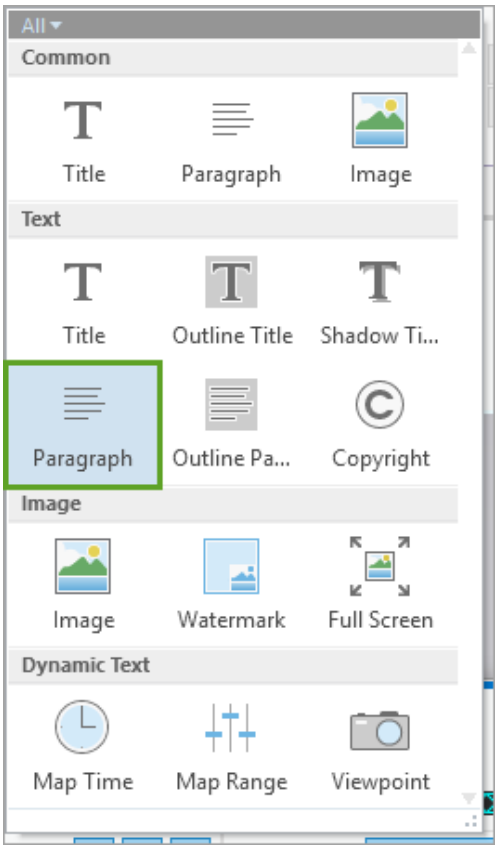
First, add a title.

1. In the **Animation Timeline**, click any keyframe to select.

2. Press **Ctrl-A** to select all keyframes in the animation.



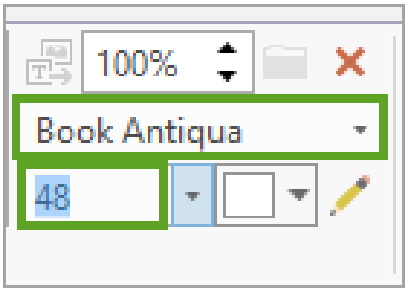

3. In the **Animation** tab, in the **Overlay** group, expand the **Overlay** gallery**,** and click **Paragraph.**



4. Type “Spain to Puerto Rico, 1770”, then click the red **X** to exit edit mode.




5. In the **Animation** tab, in the **Overlay** group, update:
    - Font to **Book Antiqua**
    - Size to **48** point



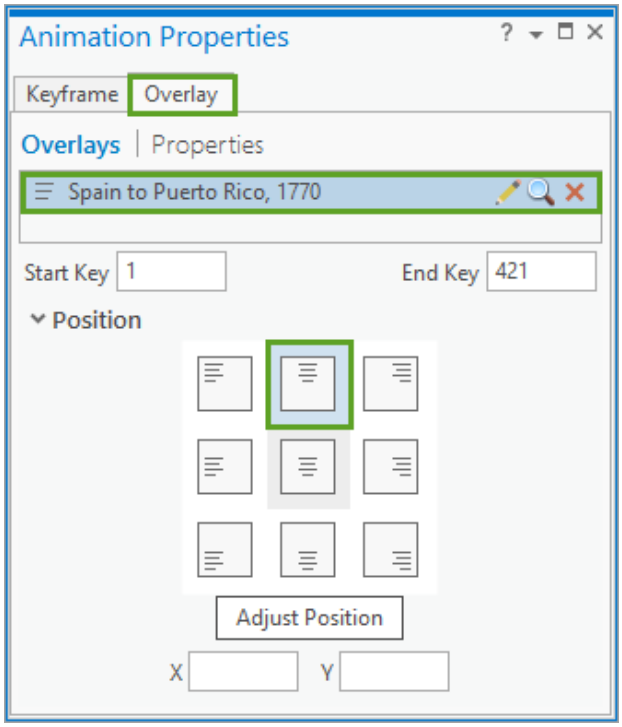




6. On the **Animation** tab, in the **Edit** group, click the **Properties** button.

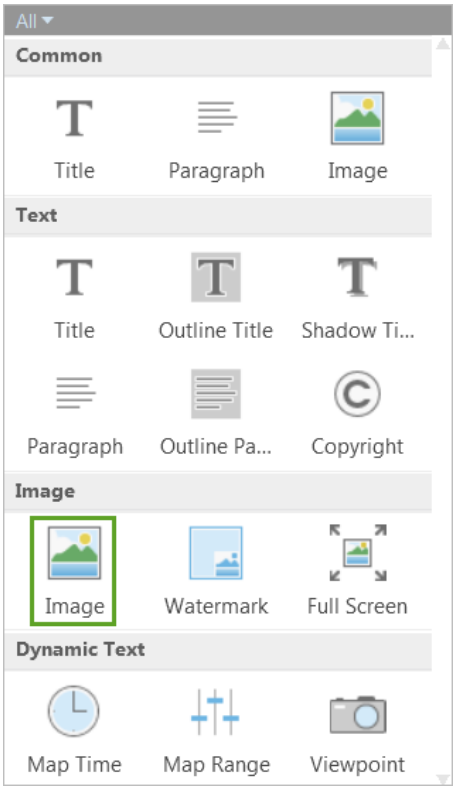
7. In the **Animation Properties** pane, click the **Overlay** tab.

8. In the **Overlay** tab, select **Position**, then **Place overlay  top- center**.

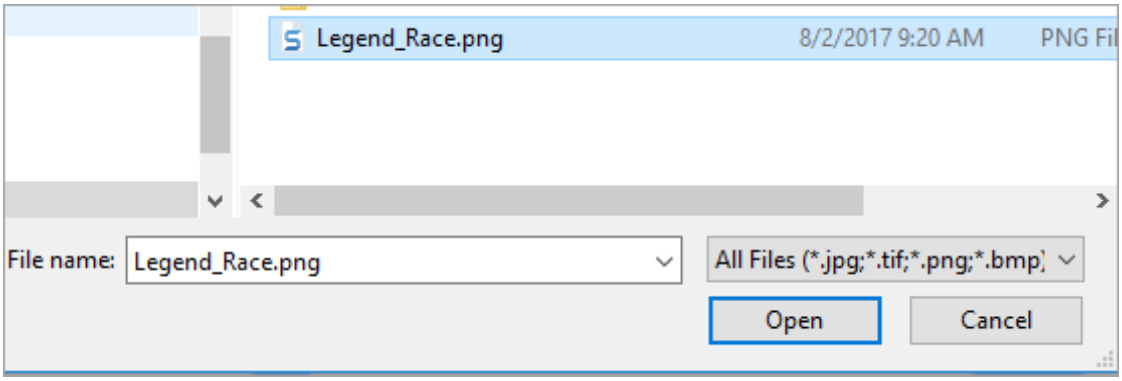



Next, add a legend.

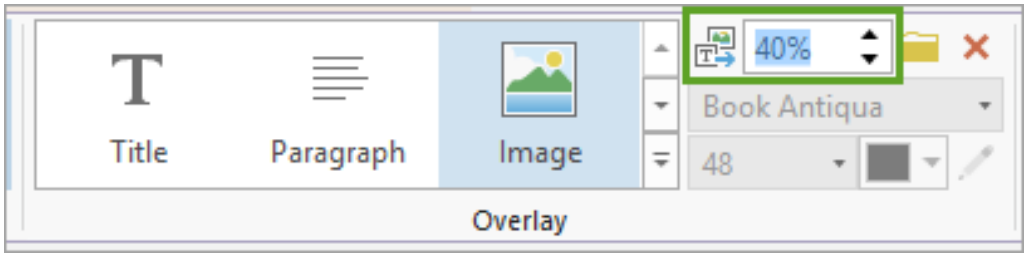
9. In the **Animation** tab, in the **Overlay** group, click **Overlay** gallery, and click **Image**.



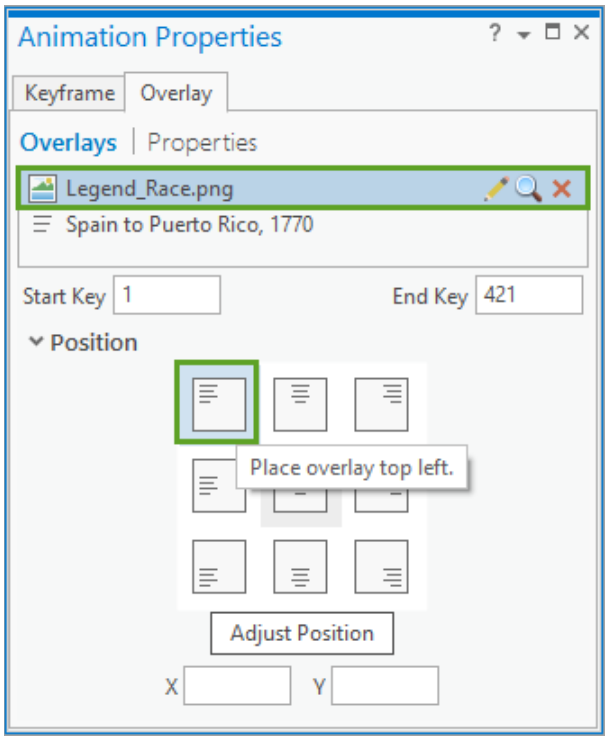
10. Browse to the folder where you downloaded the project data and choose **Legend_Race.png.**




11. In the **Animation** tab, in the Overlay group, update the size to **40%**.



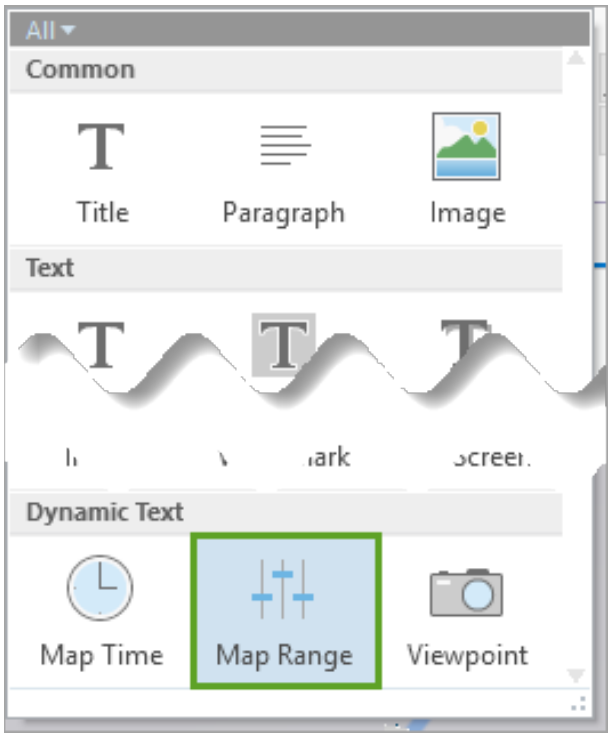

12. In the **Animations Properties** pane, select the **Legend_Race.png** element, and set the Position to Place overlay **top left**.






And lastly, add dynamic text–that changes on every frame–to show the progression of hours.

13. In the **Animation** tab, in the **Overlay** group, expand the **Overlay** gallery, and click **Map Range.**




Dynamic overlays contain specially formatted text that will read map properties and use them as the displayed value within the animation.

The default expression for Map Range, synchronizes the dynamic test displayed in the animation with the range slider Min and Max values.

```
Min: <dyn type="animation" property="rangemin" decimalPlaces="0"/>
Max: <dyn type="animation" property="rangemax" decimalPlaces="0"/>
```

14. In the **Map Range** expression box, update the expression to show only the range minimum value with the word **hours** appended to the end by completing the following:

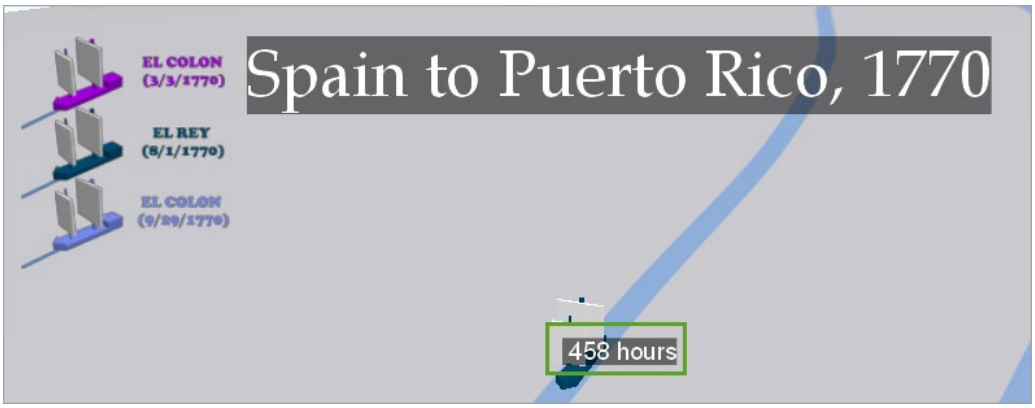
    - In the first line of the expression, delete **Min.**
    - At the end of the first line, add a space and the type the word **hours.**
    - Completely delete the second line of the expression.

    The resultant expression should read:

    *<dyn type="animation" property="rangemin" decimalPlaces="0"/> hours*

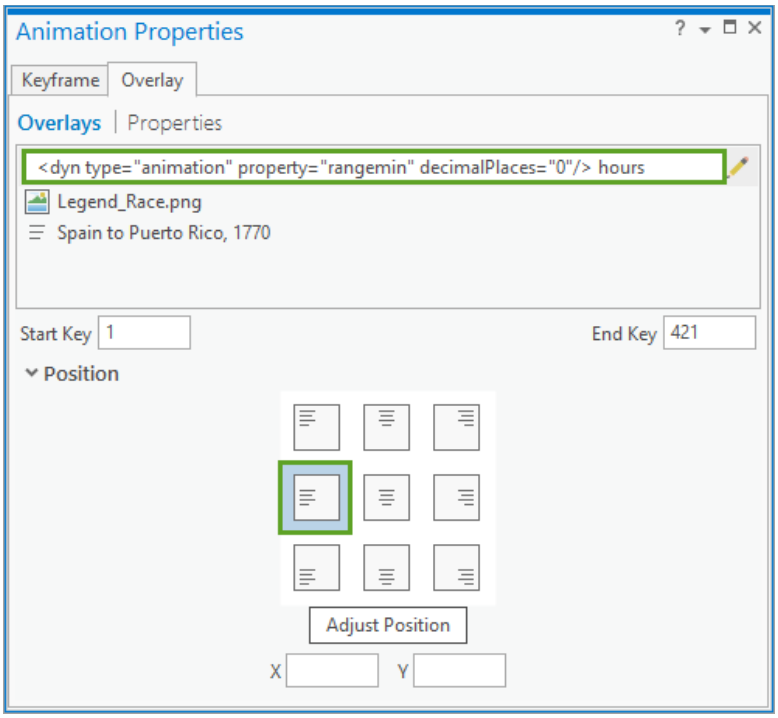
```
<dyn type="animation" property="rangemin" decimalPlaces="0"/>hours
```

15. Click the red **X** to exit edit mode.



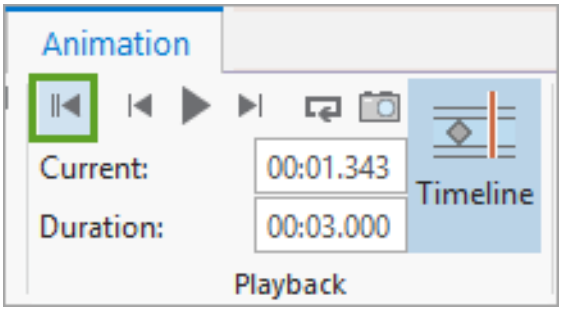

16. In the Animation tab, in the **Overlay** group, update:
    - Font to **Book Antiqua**
    - Size to **36 points**

17. In the **Animation Properties** pane, in the **Overlay** tab, select the **dynamic text** element, and select the **Place overlay middle left**.




18. Close the **Animation Properties** pane.

19. On the ribbon, click the **Animation** tab, in the **Playback** group, click the reset button to return to the start of the animation.




20. In the **Playback** group, click the play button to preview your ship race.




21. Save the project.

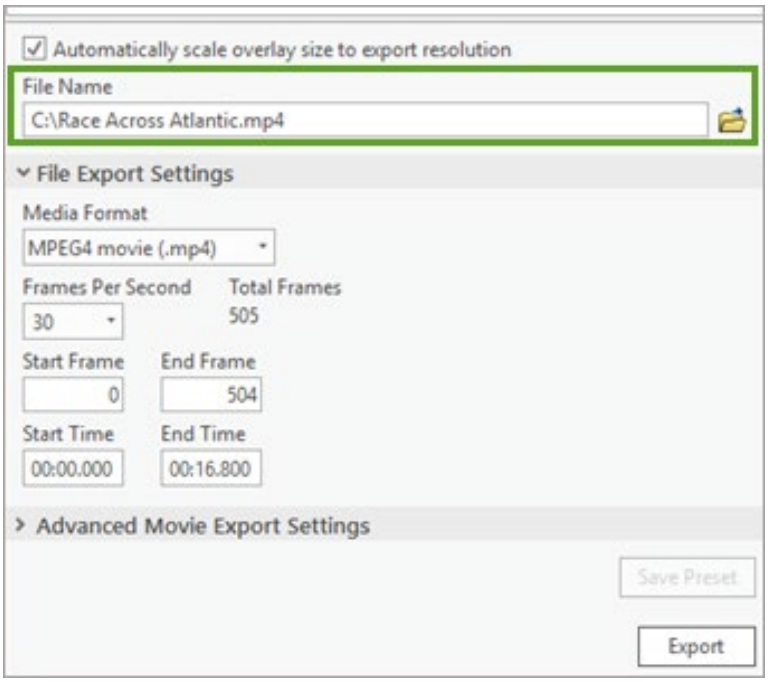
## Creating the video

Your animation is now ready for export to video. Remember to set the export frame rate to match your stop-motion rate of 25 frames per second.

1. On the ribbon, in the **Animation** tab, in the **Export** group, click **Movie**.

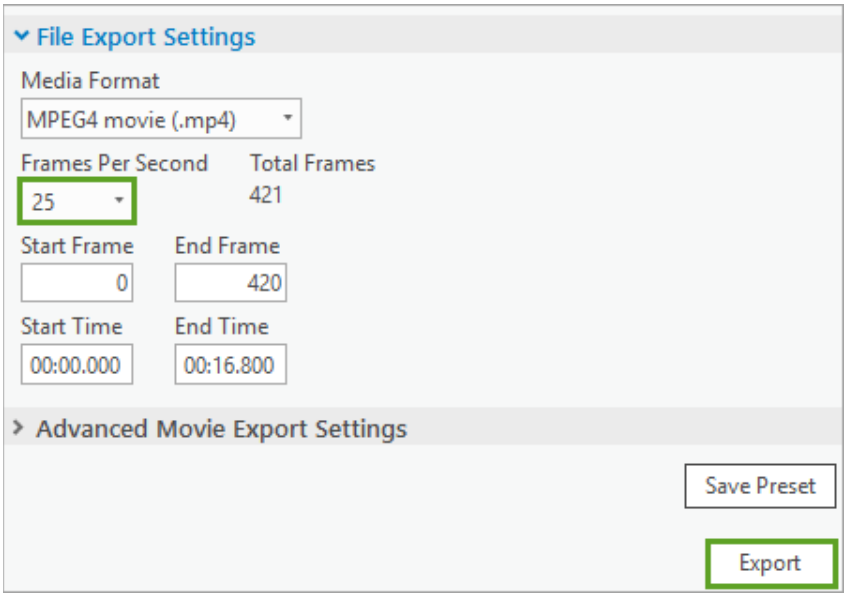
The **Export Movie** pane appears.

2. On the **Export Movie** pane, for **File Name,** specify an output location and name for your movie. For example: “C:\Race Across Atlantic.mp4”.



3. Expand **File Export Settings**.

4. Set **Frames Per Second** to **25.**

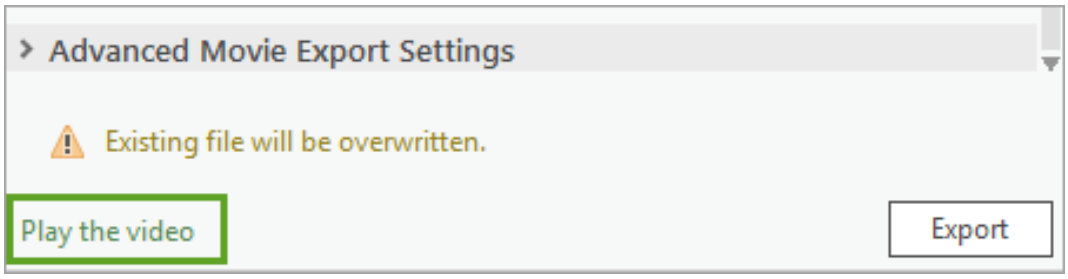



5. Click **Export.**

This animation will take several minutes to complete because the content changes in every frame. The estimated time to complete the export is shown at the bottom of the **Movie Export** pane and will vary based on your machine.

You can cancel the video export at any time by clicking the stop button, which will show the frames that have been generated to that point.

6. When the export is completed, click **Play the video** to review your work.






## Summary

In this lesson, we covered using on-screen text and images to provide details about the contents of the video, and mimicking moving objects via a stop-motion technique.

There are many other capabilities available within animations–for example, you can set the transition type between keyframes to linear, fixed curve, hopped, and stepped, or use the scene's lighting to cast shadows through time–so spending more time reading the help or watching these instructional videos is highly recommended.