THE GEO PROJECT
GEOSPATIAL EDUCATION & OUTREACH

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GEO TUTORIAL

#QGIS
Dealing with Coastal Flooding series, part 9:
CREATING AND ANIMATING TIMESERIES

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The Geospatial Education and Outreach Project (GEO Project) is a collaborative effort among the Geosystems Research Institute (GRI), the Northern Gulf Institute (a NOAA Cooperative Institute), and the Mississippi State University Extension Service. The purpose of the project is to serve as the primary source for geospatial education and technical information for Mississippi.

The GEO Project provides training and technical assistance in the use, application, and implementation of geographic information systems (GIS), remote sensing, and global positioning systems for the geospatial community of Mississippi. The purpose of the GEO Tutorial series is to support educational project activities and enhance geospatial workshops offered by the GEO Project. Each tutorial provides practical solutions and instructions to solve a particular GIS challenge.

CREATING AND ANIMATING TIMESERIES

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REQUIRED RESOURCES

– QGIS 3+

FEATURED DATA SOURCES

– Click here to access dataset used in this tutorial (14.55 MB).

OVERVIEW

Coastal areas across the United States face increasing challenges from changing water levels, which can lead to more frequent flooding and infrastructure strain. In communities like Bay St. Louis, Mississippi, rising water can make roads impassable, damage property, and disrupt daily life—posing serious concerns for homeowners and local economies.

As part of a planning team, your role is to assess how changing sea levels may impact the safety, infrastructure, and long-term growth of this Gulf Coast community. The focus is on protecting property, ensuring economic stability, and strengthening community resilience. This is the theme of the *Dealing with Coastal Flooding* tutorial series, which includes the following topics:

– Part 1: Creating Raster DEM from LiDAR Data
– Part 2: Spatial Predicates: Preparing Residential Data
– Part 3A: Using Unsupervised Machine Learning for Land Use Land Cover Classification
– Part 3B: Using Supervised Machine Learning for Land Use Land Cover Classification
– Part 4: Hydrologic Raster Preparation: Resampling and Burning Stream Network
– Part 5: Generating Flooding Extent with Raster Calculator
– Part 6: Calculating Spatial Statistics of Inundated Areas
– Part 7: Creating 3D Maps of Flooding Projections
– Part 8: 3D Map Animations
– **Part 9: Creating and Animating Timeseries**

In the previous tutorials, we created a 3D animation of our area of interest in 3D, highlighting inundated areas. Now we will create a time series and animation of water reach progression over time. This is the last tutorial in the *Dealing with Coastal Flooding* series.

DATA

For this tutorial, we will use the aggregated SLR data prepared in the previous parts. If you don't have this data, you can use the Featured Data Sources link above to download tutorial dataset. If necessary, add the data to a new QGIS project (Fig. 1).

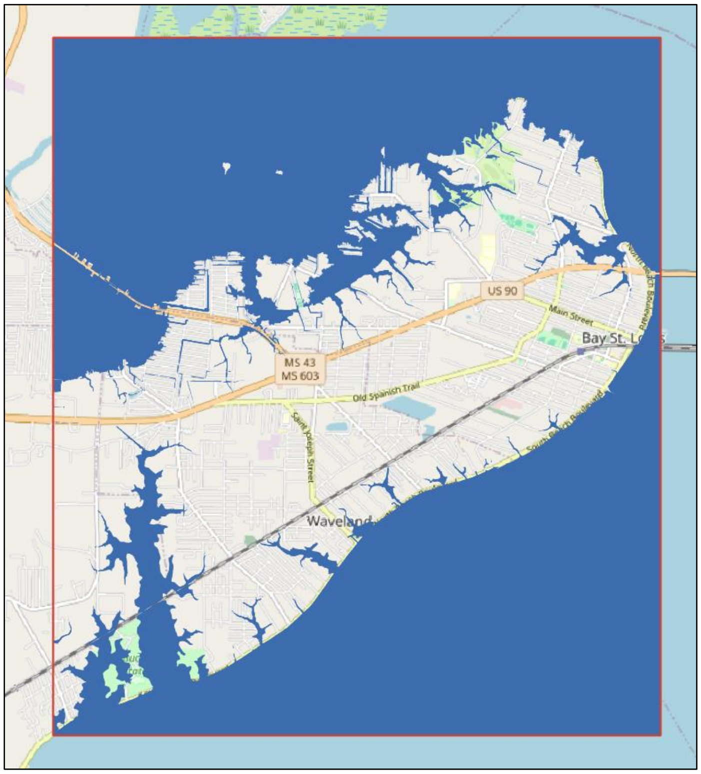

Fig. 1. *Input data as flooding projections in the Bay St. Louis area and domain extent against OpenStreetMap background.*

DEFINING TIMESERIES

To convert our *merged SLR layer* into timeseries data, we need to adjust the format of the projection year attribute (2030 to 2100). If you recall, this layer contains objects with an *integer* attribute, but we need to convert this attribute *type* to ***date***, as the current *decimal* is not supported for timeseries visualization. Open the *attribute table* of the ***SLR projections*** layer and run the *field calculator*. Create a new field *named* ***time*** and set the *type* to ***date***. In the *expression* write:

```
make_date( "yearFlood", '06', '30')
```

Here ***06*** is a random *month* in the year and ***30*** is the random *day*. Although we don't need detailed month/day information, we must provide these values for conversion to be successful. What this expression is doing, is changing information written in the *yearFlood* column (year of projection) to a date using ***30 June*** as the time to fill in missing information. Once you add the new field, save changes to the layer and turn off edit mode.

Now, open the layer properties and switch to the *Temporal* tab. Click on the *Dynamic Temporal Control* setting to turn it on. You can now set the parameters defining the time series. Since we have a date associated with each feature in the attribute table, change the configuration to ***Single Field with Date/Time*** and under *Limits* switch to ***Include Start, Exclude End***. Under the *field* setting, select the ***time*** attribute we just created. Choose it and set the *event duration* to ***10 years*** (this is our time step between projections). Click *Ok*.

Once the properties are applied, on your *Project Toolbar*, a *Temporal Controller* will become active. Open it. A new panel will be displayed (Fig. 2). If necessary, click the Animated Temporal Navigation button on the controller .

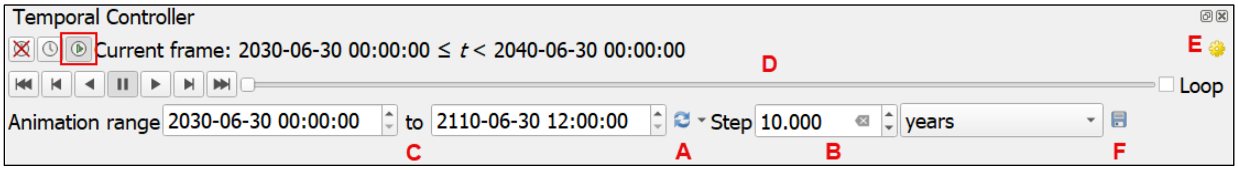

Fig. 2. *Temporal Controller used to navigate and animate time series in QGIS.*

By default, the date range is set to the current date; click the *refresh* button (Fig. 2–A) to grab the *timeframe set* to our time series and adjust the *step* (Fig. 2–B) until the *date range* (Fig. 2–C) represents our data[1]. You can use *controllers* and *timeline* (Fig. 2–D) to change the view of the timeseries on the map. This will change the visibility of the features in the layer according to the set date. You can play the animation using the play button . Similarly to 3D Map settings, you can adjust the *number of frames* using the *settings* button (Fig. 2–E).

We are almost ready to export animation frames, but let's add one more feature—a *time label*—to indicate what year projection we are looking at. To do so, open the *View* menu and under *Decorations* select *Title label*. Select *Enable Title Label*, and in the *title label text*, write:

```
[%format_date( @map_start_time , 'yyyy')%]
```

This will generate a label made from our timeseries time attribute and will display the 4-digit projection year. You can adjust *placement*, *background*, and *font* settings according to the desired style (Fig. 3).

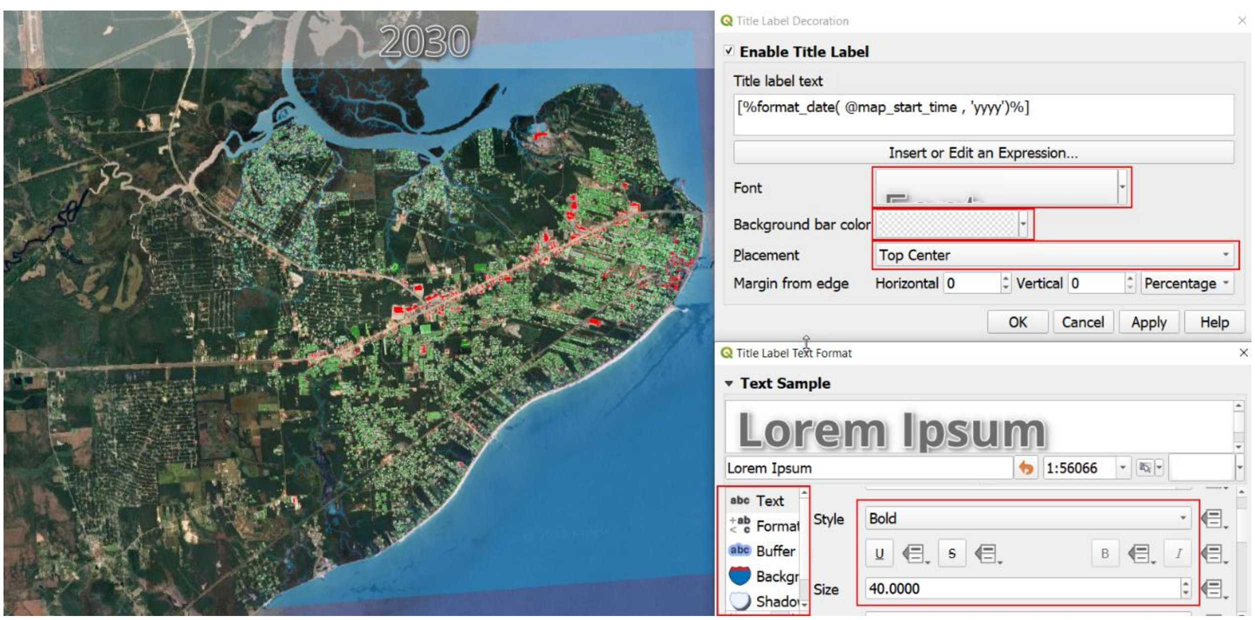

Fig. 3. *Title label decoration displays a label – in this case, projection year – serving as an indicator for the displayed data.*

[1] Note that since we set the *Limits* to ***Include Start, Exclude End*** in the temporal settings of the layer, providing the end time as 2100 will exclude that projection from the dataset, as the setting is ***Exclude End***. For this reason, we need to increase our step by one (10 years) (Fig. 2-C), or alternatively you can change the setting to ***Include Start, Include End***.

Once all the settings are there, click the *save* button (Fig. 2–F) in the *Temporal Controller* to export animation frames. During animation exporting, you can use the *Domain_extent* layer *extent* to limit the size of the output map or adjust the *resolution* manually (Fig. 4). Make sure the ***Draw active decorations: title label*** is on and check the *temporal settings* and *step* if they match our time series resolution. Then click *Save*.

Similarly to 3D Map animation, each saved file represents one frame within the animation and is a *JPEG* (*.jpg*) file by default. Since there are 8 projections, the result will be 8 files. The files must be combined to make an animated resource. You can use free software like *Resolve* to add frames and generate a *video* file (advanced option) or use any of the online tools to generate either a *video* or *GIF* file. For example, ***ezgif*** or ***imgflip*** allows you to simply upload the resulting frames and then create an animated graphic file (*GIF*).

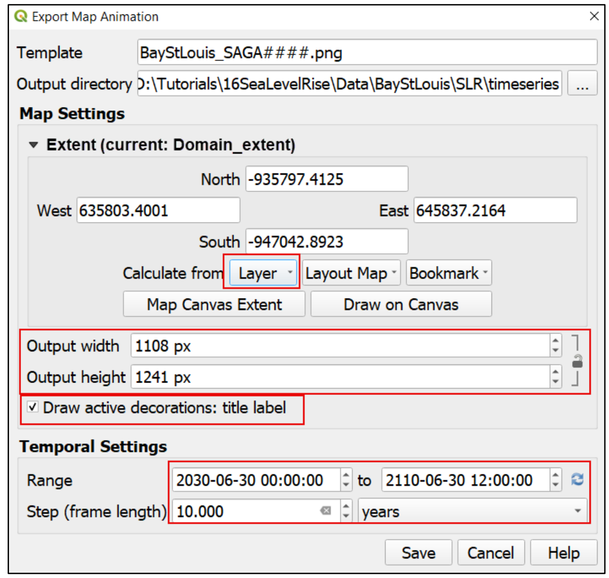

Fig. 4. When exporting frames, layer extent can be used, to limit the size extent of the animation.

CONCLUSION

In this final tutorial from the 'Dealing with Coastal Flooding' tutorial series, you created a time series animation to illustrate gradual progression of sea level changes over time. By converting the sea level rise projections into date-based attributes, you configured a temporal controller to then animate the data across various years from 2030 to 2100. This process enhances the understanding of flood impacts, enabling more effective planning for coastal resilience.

CONGRATULATIONS ON FINISHING THE *DEALING WITH COASTAL FLOODING* TUTORIAL SERIES!

This was a multi-step project that covered a variety of topics and tools. We started with processing LiDAR data into raster files to generate DEM and DSM datasets. We then used spatial predicates to integrate various datasets and applied machine learning to automate land use and land cover identification. We then modified the raster to force hydrological connectivity and used the raster calculator to compute coastal flooding extents and identify the properties that may be at risk for future flooding. Leveraging QGIS's 3D capabilities, we visualized different scenarios and created engaging animations to capture the audience's interest.

We hope that you have learned a lot and that the structure of this series helped you understand not only a wide range of tools but also the organization process when working on larger projects. If you have suggestions for future tutorials or series topics, please don't hesitate to reach out to us! You can find our contact information on the first page (excluding the title page) in each of our tutorials.