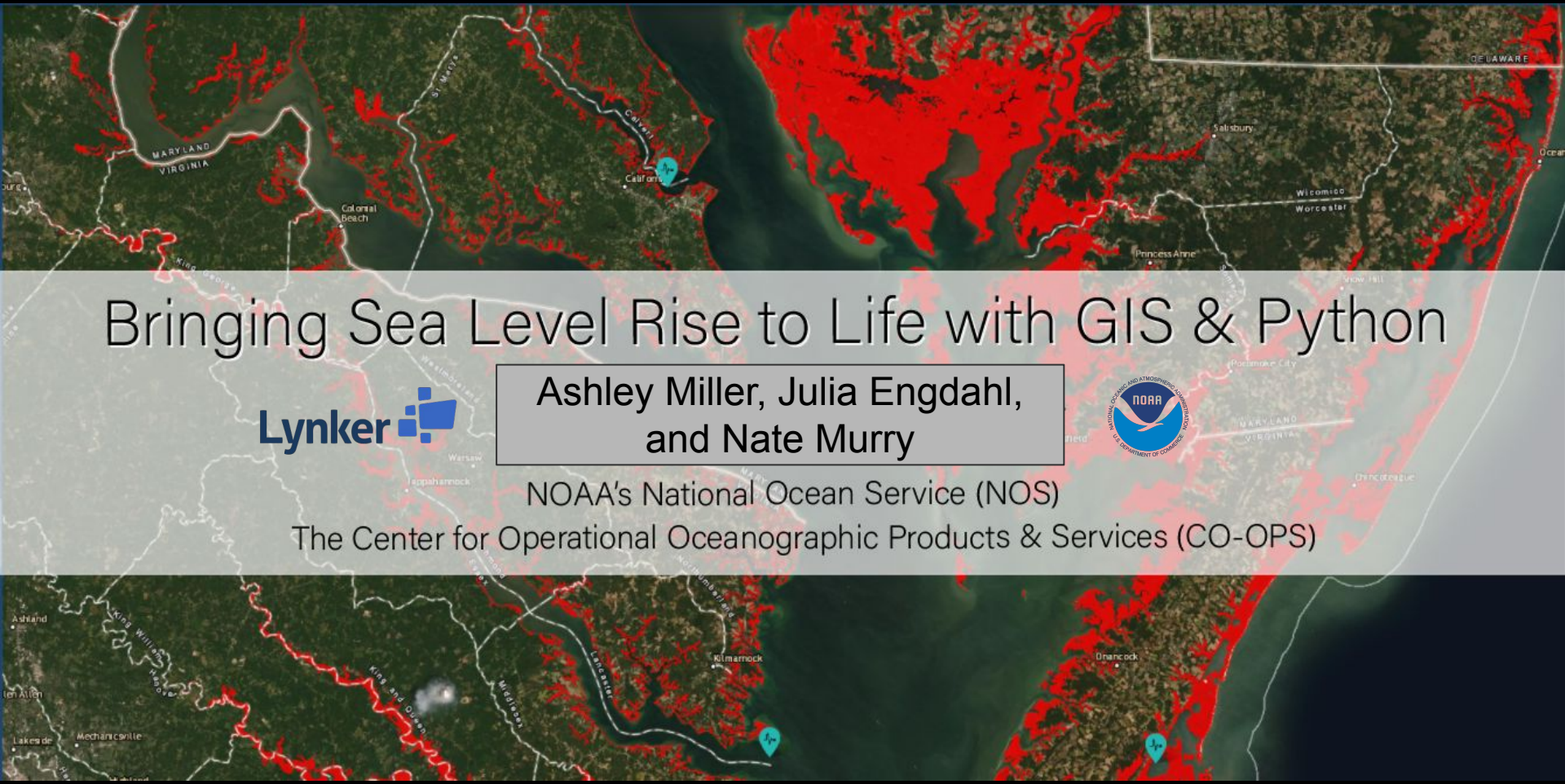


Bringing Sea Level Rise to Life with GIS & Python

Ashley Miller, Julia Engdahl, and Nate Murry

NOAA's National Ocean Service (NOS)

The Center for Operational Oceanographic Products & Services (CO-OPS)

Setting up Success

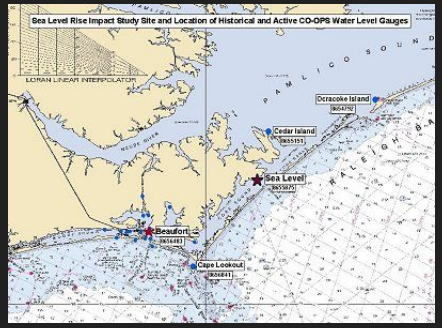
NOAA's Center for Operational Oceanographic Products & Services (CO-OPS) is the Nation's source for coastal inundation and sea level trend data.

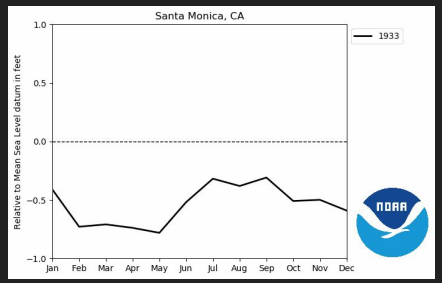
With Python, sea level trends come to life through visual, temporal, and spatial comparisons of sea level rise over time.

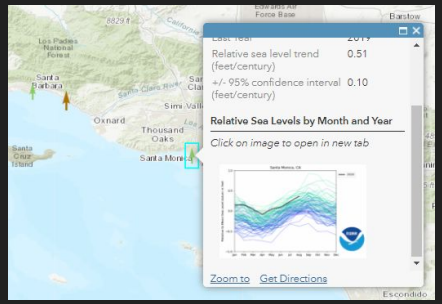
GIFs of sea level rise over time were generated for 146 CO-OPS tide stations, paving the way for improving attributes of the existing CO-OPS sea level trends map layer.

Enhanced trend animations are on the path to being available through NOAA's Climate Resilience Toolkit; focusing science and information for a climate-smart Nation.

Created in ArcGIS Pro & published to the NOAA GeoPlatform with ArcGIS Online (AGOL) via the ArcGIS API for Python.





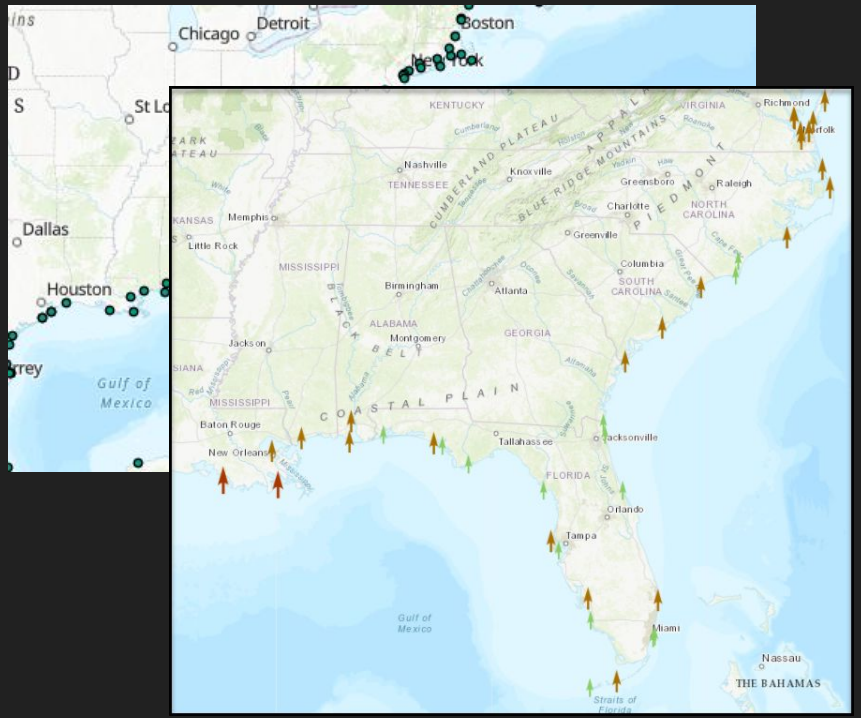


Challenges in Development

Part I: Developing GIFs & coding automated generation of the suite. With Python!

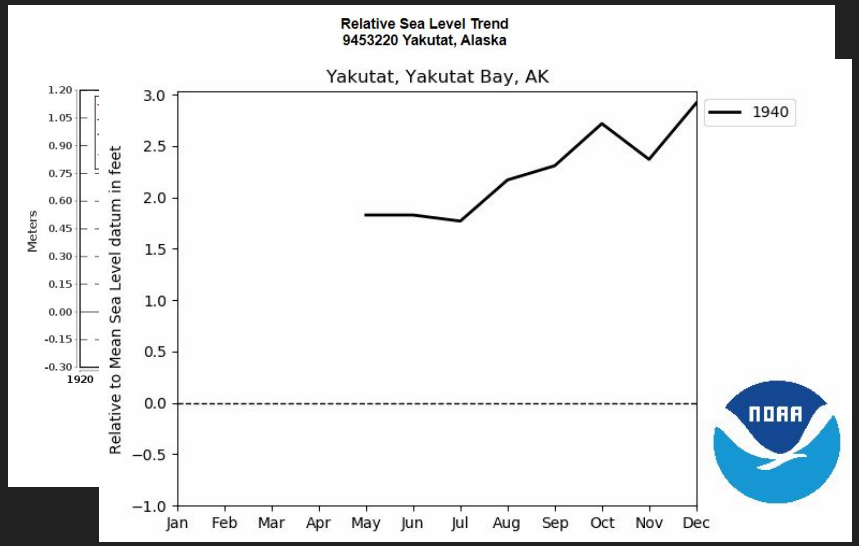
```
for stn in stnlst.idx:
    print(stnlst.index[stn])

    ## Collect data
    station=stnlst.index[stn]
    begin_date, end_date = '19200101', '20301230'
    content = mslUtils.pull_obs (station, begin_date, end_date)
    msl = mslUtils.massage_data (content, doPred=False)
    msl.loc[msl.MSL=='','MSL'] = np.nan
    msl['MSL'] = msl.MSL.astype (float)
    msl['new_year'] = msl.index
    group = msl.groupby(by='new_year')

    ## Loop through year - Add 1 year per plot
    idx=1
    winter = plt.get_cmap('winter')
    years = sorted (group.groups.keys())
    for yridx, year in enumerate (years):
        make_a_plot (yridx, year, idx, group)
        idx+=1

    ## Append 15 dummy frames
    for x in range(15):
        # yridx and year are the same as the last iteration of the year-loop
        make_a_plot (yridx, year, idx, group)
        idx+=1

    ## Create a gif
    frames = []
    imgs= glob.glob('./frames/*png')
    for img_file in imgs:
        with open (img_file, 'rb') as f:
            image = Image.open(f)
            frames.append (image.copy())
        image.close()
        f.close()
```

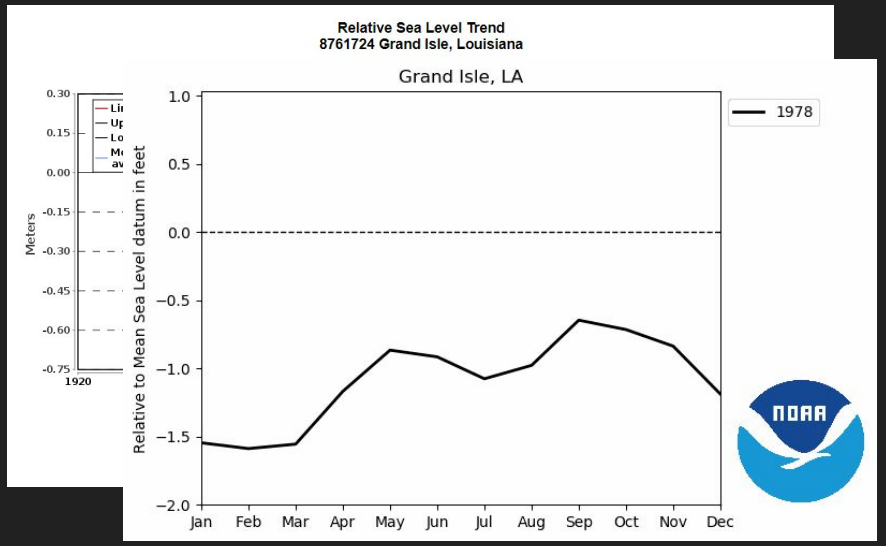
Part II: Determining how to visually represent large amounts of data.



Interpreting Trends

Sea level trends have historically been displayed as static representations (i.e. plots or trend values) for the period of calculation across public facing platforms.





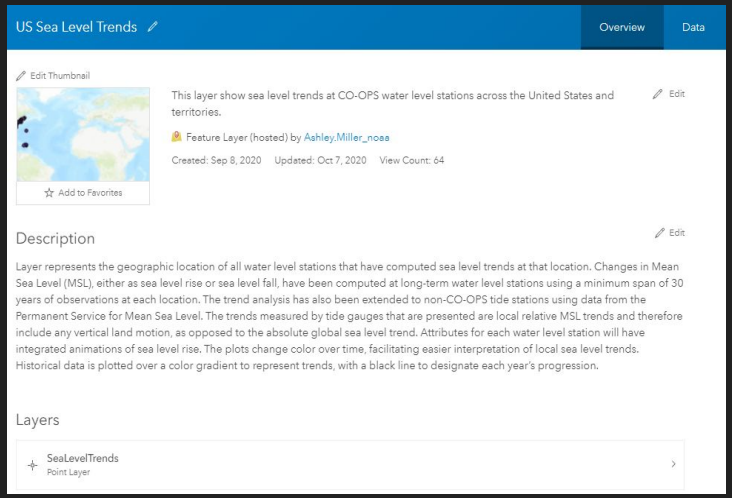
With Python, sea level trends come to life by providing visual, temporal, and spatial comparisons of sea level rise at any location.

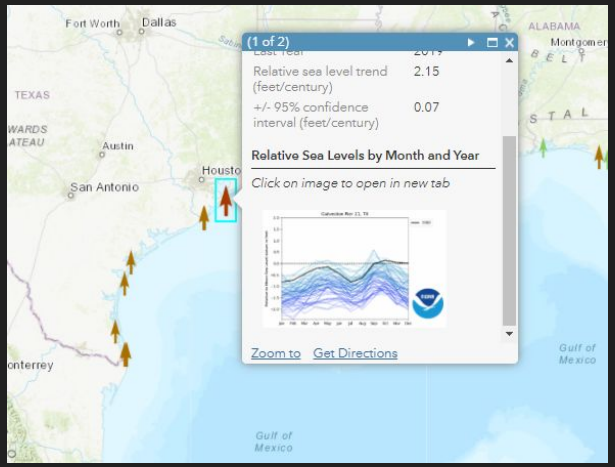
The Esri Advantage

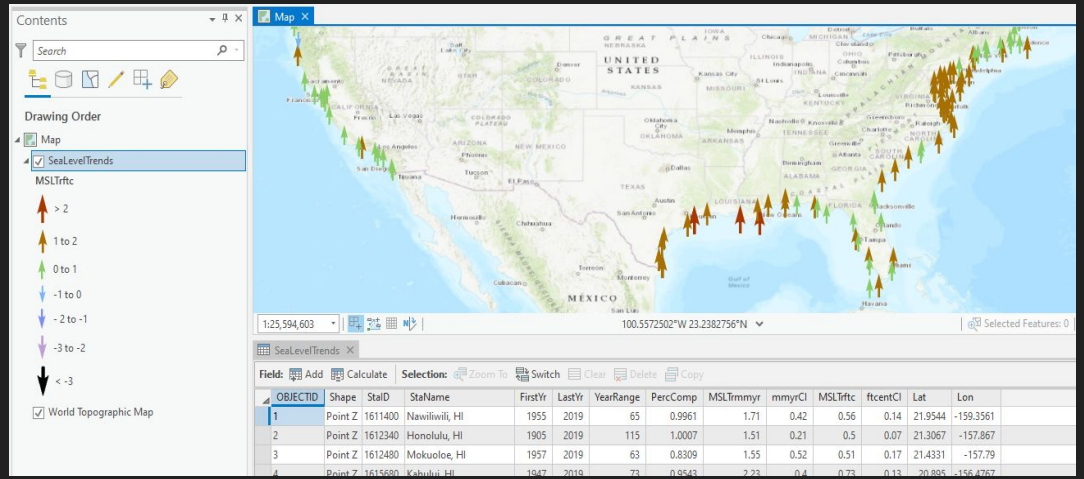
Previously sea level trends were hosted through a server, then brought in to ArcGIS Online (AGOL) manually.

With ArcPro, we enhanced the layer and hosted it on the NOAA GeoPlatform, now available in AGOL

Then integrated GIF visualizations by customizing the pop-ups!







Applying New Technology

SeaLeGS: The Sea Level Trends GiS Update Tool

A user-configurable Python Toolset that leverages the powerful ArcGIS API for Python to create, add & update GIS content from internet data (REST services, tabular data, JSON, and others). Originally developed for work on sea level trends, it has since expanded its capabilities and is now more broadly applicable. **The result is a streamlined workflow of internet data to GIS services, (manual or completely automated).**

SeaLeGS Features and Advantages:

- Highly user-configurable by code and config file
- Can be automated to varying degrees or 100%
- Performs web scrapes against numerous data types, (map / feature services, JSON, CSV, text, etc.
- AGOL credentials secured by Cython PYD for delegating update tasks to others
- Update tasks are callable in other Python scripts
- Tightly integrated with ArcPro and AGOL

```
================================================================
CO-OPS SeaLeGS -- The SEA LEvel trends GiS layer update tool)
Verson 2.0 Beta, (5.6.2021)

Written by Nate Murry, (Nathan.Murry_NOAA)
NOAA / NOS / CO-OPS / Oceanographic Division
================================================================
```

```
A local CO-OPS ArcGIS Online credential profile was found in the Windows Credential Manager:  "coops_agol".

Successfully logged into ArcGIS Online as "NOS.COOPS_noaa".

Searching ArcGIS Online content under "NOS.COOPS_noaa" for an existing shapefile and service definition to update...

The following shapefile & hosted feature service were FOUND on ArcGIS Online:
```

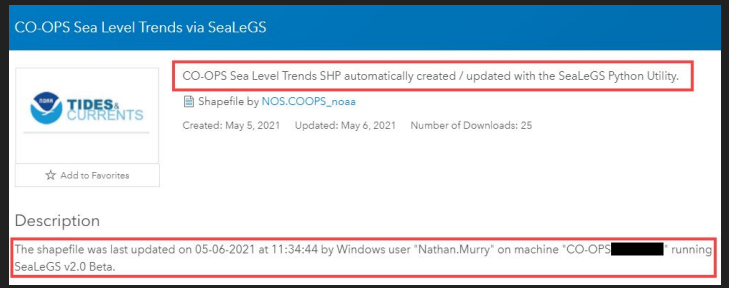
Applying New Technology

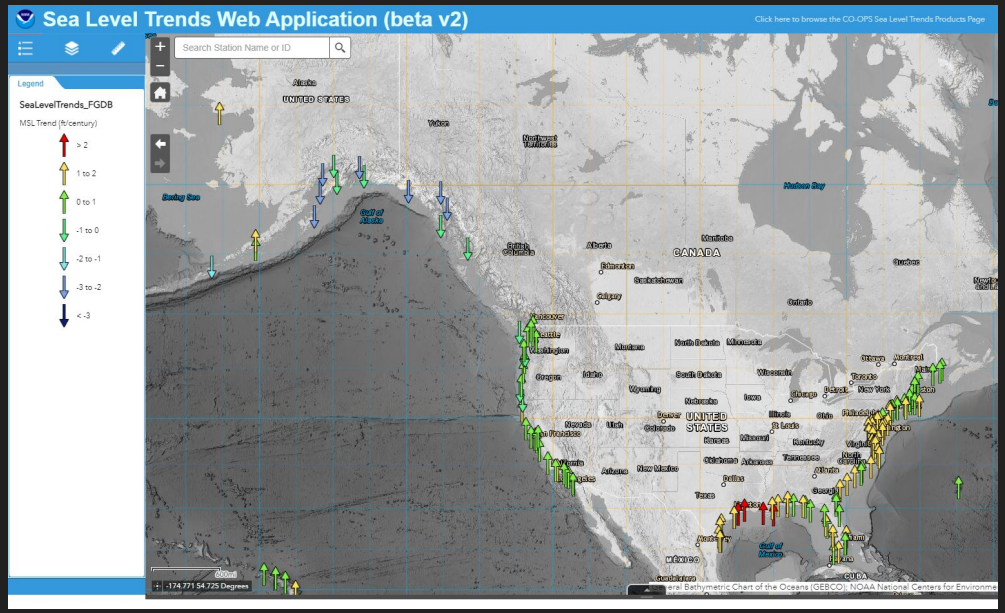
SeaLeGS: Sea Level Trends GiS Update Tool

```
The shapefile was successfully updated from the local ZIP archive.

The shapefile, service definition and hosted feature class were successfully updated on ArcGIS Online.

All automatically created or updated content was successfully shared with the NOAA organization.

ALL SEALEGS OPERATIONS WERE SUCESSFULLY EXECUTED.
```

SeaLeGS Features and Advantages con't:

- Once GIS content is acquired, processed and added / updated to ArcGIS Online, webmaps and applications are updated automatically as well.
- Additional extensibility and customization is possible when creating custom web applications via the Web AppBuilder Developer Edition

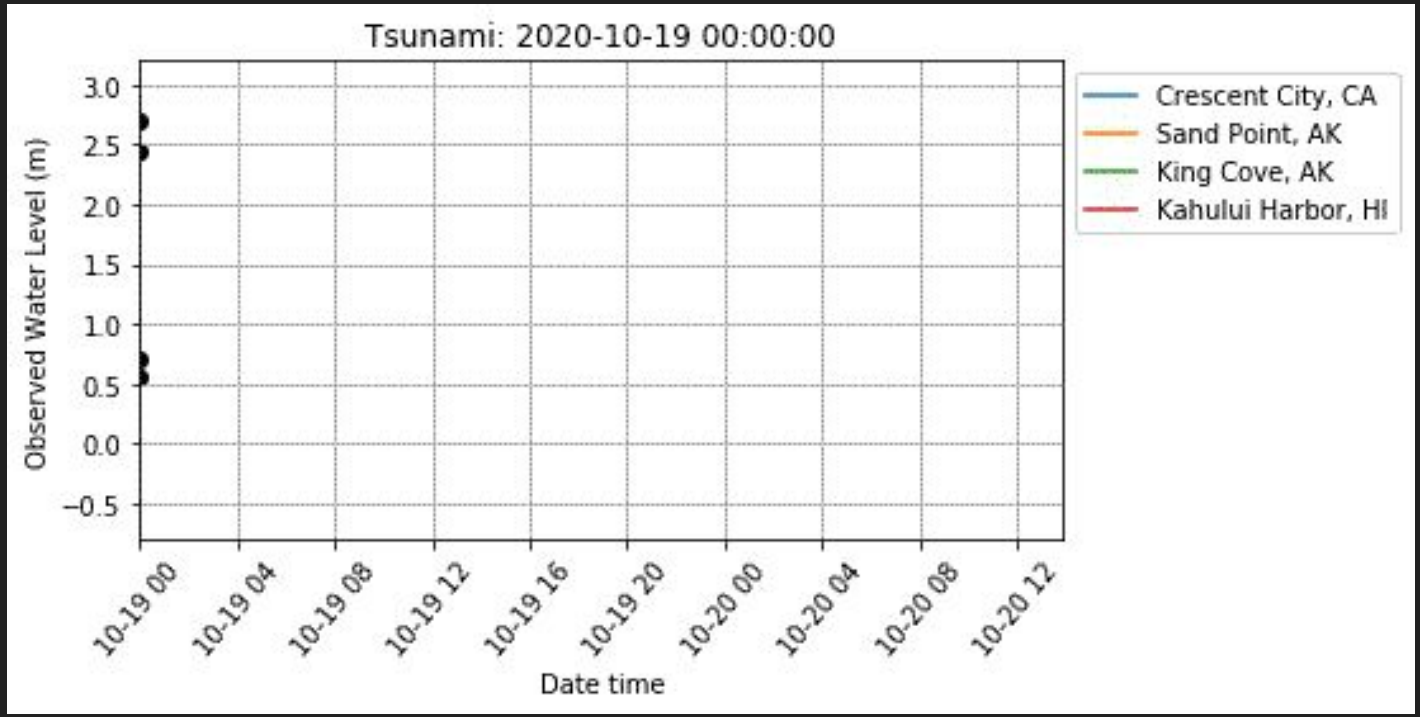




Applying New Technology

Methodology used to develop sea level trends GIFs can be used to enhances additional CO-OPS products, like water level & temperature.

Next stop - Esri's Living Atlas!



Animation of water levels capturing the tsunami signal at two Alaska stations near the epicenter of the October 19, 2020 Alaska earthquake (Sand Point & King Cove), along with Kahului Harbor, HI and Crescent City, CA.